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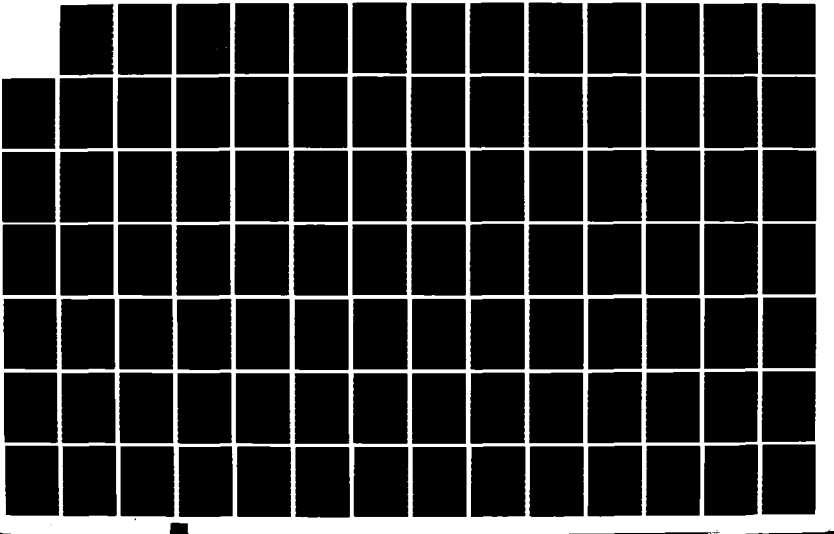

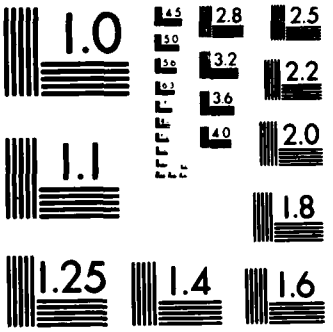

DESIGN GUIDELINES FOR TRAINER INSTRUCTOR/OPERATOR STATIONS

(12)

Technical Report: NAVTRASYSCEN 83-C-0087-1

DESIGN GUIDELINES FOR TRAINER INSTRUCTOR/OPERATOR STATIONS

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San Diego, CA 92106

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Final Report

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20 ABSTRACT (Continue on reverse side if necessary and identify by block number)

The application of advanced display and control technology to training device design has often resulted in an instructor/operator interface which is not optimum. Recent reviews of operational trainers have revealed a variety of problems. Most of them are attributed to the lack of application of existing human engineering/interface criteria and the failure to extend the system's approach to the instructor/operator interface design

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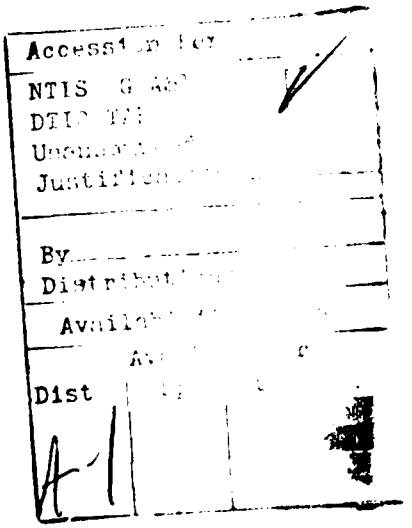
and implementation. Surveys were conducted of operational trainers. A design guide was developed which outlines both procedures and data required at various milestones throughout the life cycle of a major training device/simulator to achieve an effective interface. Summaries of instructional features, display and control panel abbreviations and general instructor/operator station functional requirements were also developed.



SUMMARY

It became clear following a series of reviews of trainer operating consoles that a variety of operability and related training effectiveness problems existed in many operational trainers. It appeared that similar problems would occur in future trainers unless the procedures and methods for the design of trainer consoles were revised and implemented. Therefore, a project was undertaken to develop a new set of guidelines for the design and development of trainer instructor/operator stations.

The earlier reviews had pointed out a basic overall lack of application of both systems methodology and human factors engineering criteria to the design of training device instructor/operator stations. Both the methodology and the criteria existed. Therefore, the general approach employed for the preparation of the guide was to develop detailed procedures for console definition, development and support utilizing that methodology. Since the approach (the systems engineering approach) should also be utilized overall for the trainer development project.

The guidelines contained in this report are divided into three sections reflecting the three basic phases of training device procurement, namely:

o Precontract Phase - directed to the analysis of the requirement and development of the procurement specifications,

o Acquisition Phase - directed to the design and development of the trainer and its test and acceptance,

o Support Phase - directed to support of the trainer including update and modification during its operational life.

The guidelines are life cycle procedure oriented and rely on the utilization of existing design criteria. They are considered to be adequate and has proven effective over the years when applied within the systems engineering approach.

Among the major problems which surfaced in the reviews of trainer consoles was the lack of consideration of instructional requirements and user characteristics in the design. Thus the guidelines are directed more to the effort required in monitoring and evaluating products of the design process and ensuring that the steps are completed, rather than with specifying specific design solutions. The latter approach which must necessarily be identified and associated with a particular state of technology, is rapidly outdated as new technology is developed. Finally, solutions without a problem statement rarely succeed in meeting an operational requirement.

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PREFACE

Many training system managers, instructors, operators and designers contributed their time, knowledge and experiences to the development of this report. The simulation training community must certainly be unique not only in the cooperation typically found, but also in the interest uniformly expressed in identifying and solving any deficiencies or effectiveness problems. Appreciation is expressed to the many individuals who assisted in the surveys of the training devices involved in this study.

In addition, the assistance of the Scientific Officer, Dr. Dee Andrews, in coordinating the many visits required and most importantly in criticizing and assisting in structuring the guide format is acknowledged.

FOREWORD

This report follows previous reports that detailed analyses of instructor/operator stations (IOS) for three aviation trainers (Devices 2F119, 2F112, and 2E6). The present effort extended the analysis efforts to surface, sub-surface and land (armor) trainers. In addition to again looking at single and twin station operator trainers, as had been the case in the previous aviation analyses, this study also examined a large team trainer's IOS and a maintenance trainer's IOS.

Based upon the analyses of actual IOSs, the objective of this guide is to identify the tasks involved and the data required during the major training device life cycle events which impact the characteristics of trainer instructor/operator stations. The guide focuses on "what" to do in design, not "how" to do it. A guide which focused on "how" it should be done would soon be outdated since hardware and software technologies are evolving so rapidly.

Until the training device community spends as much time and effort on IOS design as it does on other aspects of the device, we can expect the problems detailed in this and previous studies to continue. The result will be devices that do not attain their full measure of training effectiveness.

Dee H. Andrews

Dee H. Andrews
Scientific Officer

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TRAINER INSTRUCTOR/OPERATOR CONSOLE DESIGN GUIDE

FOR MAJOR TRAINING DEVICES

SECTION I

INTRODUCTION

1.1 SCOPE. This guide identifies the critical analysis, development, implementation and support tasks within the life cycle of major training devices which directly establish the effectiveness and acceptability of the trainer instructor/operator station (IOS). It also defines those actions which must be taken during the design and development of a trainer to ensure that an effective and operable IOS is implemented. The guide is intended to be used by all personnel and activities directly involved in major training device instructor/operator station design, development, evaluation, modification and update.

1.2 OBJECTIVE. Training device effectiveness is largely dependent upon the characteristics of the instructional subsystem. In most trainers, this includes the instructor, the instructional software, and above all, the interfaces (both hardware and software) to the other training device subsystems. The primary interface, the trainer IOS, must be designed and supported so that the training device meets not only the training objectives, but also the user requirements. Effective design can only be achieved through identification and understanding of the characteristics of the user and the required training, and then ensuring that these data are reflected in the design of the console. The design task also requires detailed monitoring of the design effort to ensure that the necessary data are available and input to the design effort. It is therefore the objective of this guide to identify the tasks involved and the data required during the major training device life cycle events which impact the characteristics of trainer operating station. Appendix A outlines some of the functional characteristics of the instructor/operation station.

1.3 BACKGROUND. A series of studies conducted by the Naval Training Systems Center in 1983 and 1984 pointed out that major operating problems both in terms of acceptance and usage, existed in many of the major aviation training devices to the detriment of training. A wide variety of causal factors were identified, most of which, it was concluded, could be solved through the proper application of existing training and human factors engineering methods and technology, and through technical monitoring of the efforts involved. It was recommended that specific guidelines be developed for console design, development and support throughout the life cycle of the trainer.

1.4 TRAINER LIFE CYCLE EVENTS. The life cycle of a major training device consists of three distinct phases which follow the development and statement of the trainer operational requirement. These

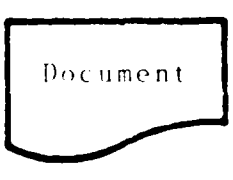
are the precontract phase, the acquisition phase and the support phase. The precontract phase begins with the statement of the operational requirement and ends with the selection of the development contractor. The acquisition phase begins with the award of the development contract and concludes when the trainer is ready for operational training. The support phase begins with the acceptance of the trainer for training and concludes when the trainer is "retired." Each of the phases consists of a series of tasks which must be completed.

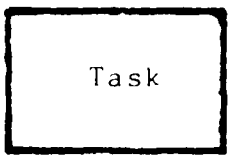
Figure 1 summarizes the major tasks involved in the overall trainer life cycle in flow chart format. Although depicted as sequential, many of the tasks, especially in the support phase, are iterative in nature. Not all of the tasks illustrated are directly relevant to IOS design. For example, some of the early tasks in the precontract phase can occur prior to promulgation of a trainer requirement statement. Others only indirectly reflect the IOS such as conducting of support reviews or the reporting of trainer utilization. However, they are shown to illustrate the major overall life cycle events. They form the point of departure for the IOS life cycle tasks outlined in Sections III, IV and V.

1.5 TRAINER REQUIREMENTS DEFINITION BACKGROUND. Figure 2 outlines the requirements definition tasks and related data which should be generated prior to the development and promulgation of the trainer operational requirement statement. The figure is idealistic both in terms of the sequence of tasks and the analyses which should be completed. However, to the extent that the tasks outlined are not completed, the trainer requirement statement must be considered to be defective in that required data will not have been generated. The burden is then placed on the next phase, the trainer precontract phase tasks as will be discussed.

The tasks, as shown in Figure 2, are weapon system oriented. However, requirements for general purpose or generic system task trainers such as general sonar or tactics trainers should and can be developed using the same tasks.

The tasks begin after the weapon system requirement has been formalized as represented in Figure 2 by the documentation symbol. (The tasks as represented by the square box.)





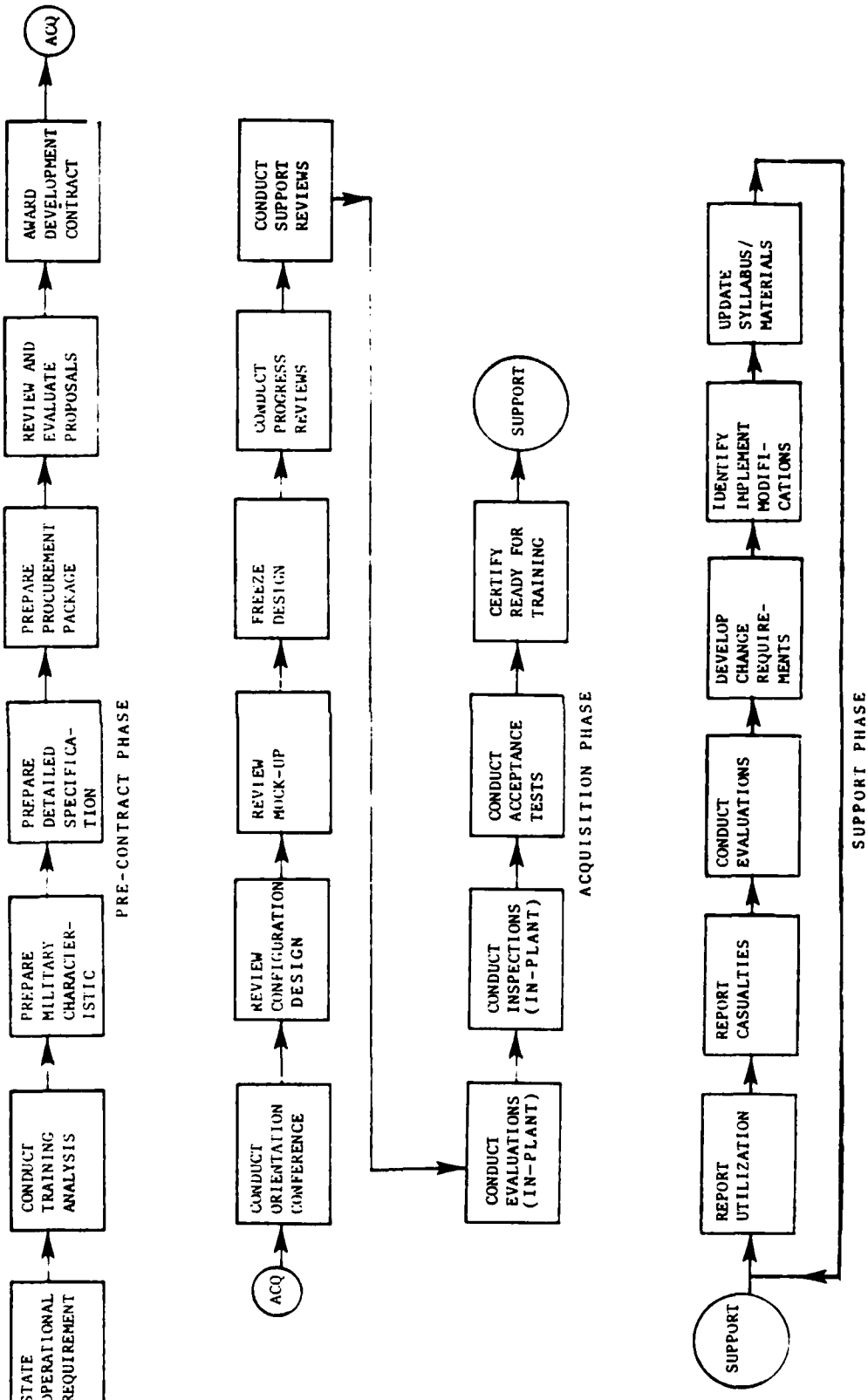


Figure 1. Major trainer life cycle events

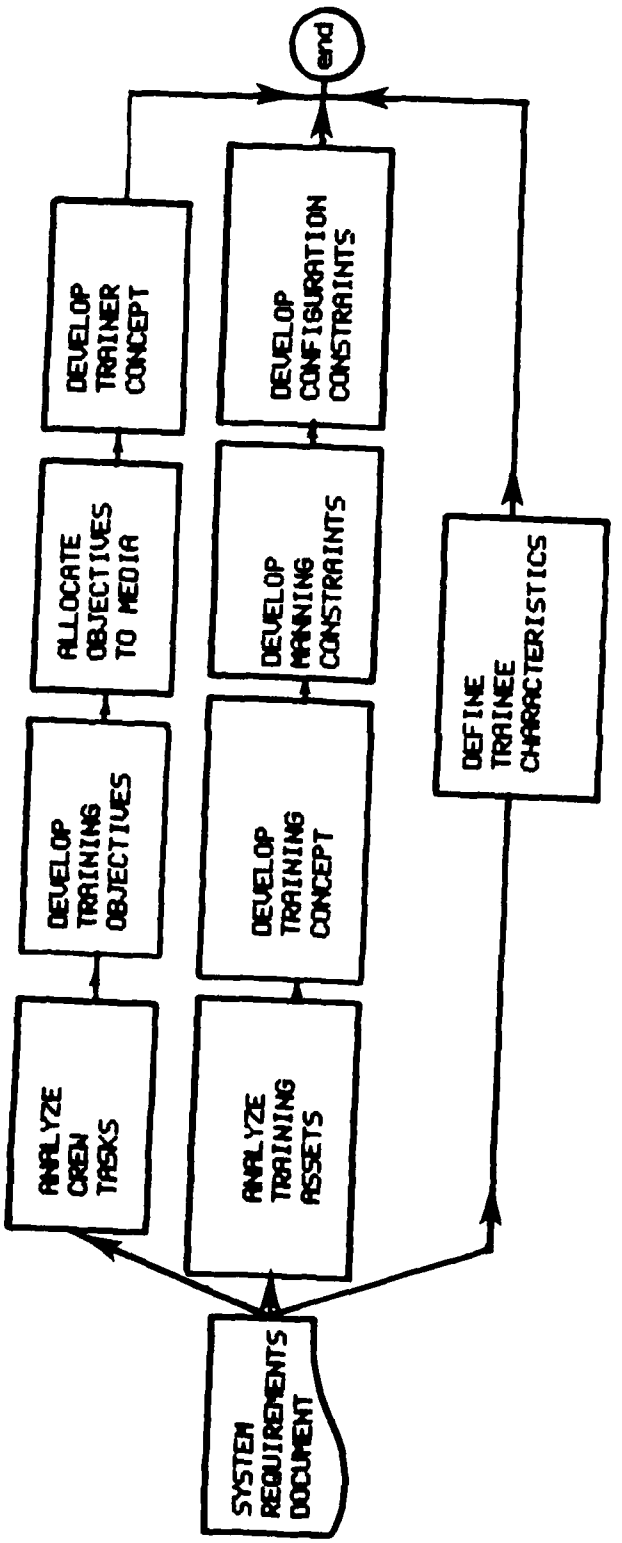


Figure 2. Training operational requirements definition.

The top row of tasks are primarily concerned with identifying the training requirements for the weapon/support system. As can be seen, these include an analysis of the system tasks, the development and allocation of the training objectives and finally, the development of the trainer concept based on the allocated objectives. These data are documented in response to DIDs (Data Item Description) such as UDI-H-25713B - Task Listing report, in response to MIL-T-29053 - Requirements for Training Systems Development or DI-H-7068 - Task and Skills Analysis Report, as outlined in MIL-STD 1379B - Contract Training Programs.

The center row of tasks is directed to structuring the trainer configuration with reference to identified constraints and the overall training concept and assets available. These data are called out in DIDs UDI-H-25710B - Program Analysis Report, or DI-H-7066 - Training And Training Equipment Plan.

The bottom row task addresses the problem of identifying the student or trainee characteristics. Typical data is reflected in DID UDI-H-25714B - Student Entry Level Report.

The output of these tasks is a detailed operational requirement for the training device as one component of the weapon system training system. The data from each of the tasks identified in Figure 2 is essential to the development of an objective and definitive requirement statement. The data from each of the tasks is also required during the training and engineering analyses, design and development of the trainer.

1.6 DEFINITIONS. A variety of terms has been utilized to identify the consoles utilized to operate training devices with resulting confusion. Therefore a set of definitions has been developed. They distinguish not only between the IOS and the computer operating console but also between the different stations utilized for the operation of the trainer during the training exercises. The term "instructor/operator station" will be used to include all stations which are utilized in training as distinct from, for example, a computer operating console or terminal which is utilized only in powering up the computer system, loading programs, running diagnostics and tests, powering down and nontraining operations utilizing the computer system. Appendix B defines the terms involved. Military Handbook MIL HDBK 220 Glossary of training Device Terms contains other definitions related to trainer IOS development.

1.7 GUIDE ORGANIZATION. Section II of the guide identifies the applicable documents. Sections III, IV, and V outline the IOS tasks involved in each of the three phases of trainer development, i.e., pre-contract phase, acquisition phase and the support phase. Each of the tasks will be discussed in terms of objectives, required inputs, actions required, outputs, and contingency tasks or data required to supplant missing inputs.

In addition, Appendix H contains a suggested list of IOS display and control panel abbreviations commonly used in training devices along with an algorithm for generating abbreviations.

A selected set of references with brief annotation is also appended as a source of additional information on IOS design.

SECTION II

APPLICABLE DOCUMENTS

The following documents of the issue in effect form a part of this guide.

SPECIFICATIONS

MIL-M-18012	Markings for Aircrew Station Displays, and Configuration
MIL-T-23991	Training Devices, Military, General Specification for
MIL-C-25050	Colors, Aeronautical Lights and Lighting Equipment, General Specification for
MIL-C-29025	Communication Systems for Training Devices, General Specification for
MIL-C-29053	Training Requirements for Aviation Weapon Systems
MIL-S-38039	Systems, Illuminated, Warning, Caution, and Advisor, General Specification for
MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities
MIL-C-81774	Control Panel, Aircraft, General Requirements for
MIL-T-82335	Trainer, Fixed-Wing, Flight: General Specification for

STANDARDS

MIL-STD 1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-STD 411	Aircrew Station Signals
MIL-STD 783	Legends for Use in Aircrew Stations and on Airborne Equipment
MIL-STD 203	Aircrew Station Controls and Displays for Fixed Wing Aircraft
MIL-STD 250	Aircrew Station Control and Displays for Rotary Wing Aircraft

MIL-STD 1333 Aircrew Station Geometry for Military Aircraft

MIL-STD 721 Definition of Effectiveness Terms for Reliability, Maintainability, Human Factors and Safety

FED-STD 595 Colors

HANDBOOKS

MIL HDBK 220 Glossary of training Device Terms

INSTRUCTIONS

CHIEF OF NAVAL OPERATIONS

OPNAVINST 1500.51 Surface Warfare Training System Policy, Organization and Responsibilities.

OPNAVINST 1500.11 Aviation Training Policy, Organization and Responsibilities.

OPNAVINST 1551.7 Fleet participation in development, acquisition and acceptance of major training devices.

OPNAVINST 5220.9 Quality assurance and revalidation of training devices.

OPNAVINST 5442.4 Aircraft, Training Devices and Support Equipment Material Condition, Mission-Essential Subsystems Matrices, and Mission Descriptions.

Naval Training Systems Center

NAVTRASYSCENINST 1551.8 Training device mock-up reviews; policies and procedure for.

NAVTRASYSCENINST 3910-4 Functional Statement, Functional Description, Mini-Military Characteristics, and detail Military Characteristics; instructions and responsibilities for.

NAVTRASYSCENINST 4720.1 Field Requests for changes to training device and simulators under the inventory management of the NAVTRASYSCEN (Cognizance Symbol 2 "O"); procedures and information concerning.

SECTION III

IOS PRE-CONTRACT PHASE TASKS

3.1 GENERAL. As illustrated in Figure 1, the pre-contract phase for a trainer includes all of the analyses and documentation steps involved in translating the trainer operational requirement into a procurement or design specification. Figure 3 outlines the pre-contract phase tasks specifically concerned with the IOS subsystem. The tasks are outlined in a flowchart which is generic in nature. The detailed task flow for any training device IOS will vary with the specific requirements and training objectives involved.

The task flow in Figure 3 also fails to illustrate both the interaction of the tasks in terms of data and analyses and the repetitive nature of the tasks. The results of most of the tasks must be considered in the other analytical tasks which must in turn be revalidated based on other inputs. The necessity for validating preceding analyses following subsequent analyses and data cannot be overemphasized. A PERT (Program Evaluation Review Technique) style of flow chart should be created for each project to relate the outputs of the tasks to subsequent tasks and to indicate the flow of data between tasks. Critical paths can be created once completion time data have been developed.

The Fleet Project Team (FPT) which is established for each weapon system and trainer provides a major input to this phase in terms of user requirements, training concept, manning concept and subject matter expertise, both in weapon system and related trainer characteristics. The FPT is defined and established in accordance with Chief of Naval Operations Instruction 1551.7 "Fleet Participation in Development and Acceptance of Operational Flight/Weapon System Trainers (OF/WSTs) and Other Major Aviation Operational Training Devices."

3.2 PRE-CONTRACT PHASE TASKS. Each of the tasks outlined in Figure 3 will be reviewed in terms of its objective, inputs, actions, outputs, and impact on trainer IOS acquisition and support. Contingency subtasks which must be completed if the required inputs are not available are also described. These subtasks are not a substitute for the basic task requirements in terms of inputs and should only be utilized where the input data is missing and insufficient time remains to complete the preceding tasks. However they do not provide the full set of inputs required. When utilized, subsequent verification and validation of the results of the task must be undertaken as soon as possible.

Each task is described on a separate page(s) to facilitate guide utilization and update. The tasks are numbered sequentially as (PC-n) tasks for ease in relating back to Figure 3.

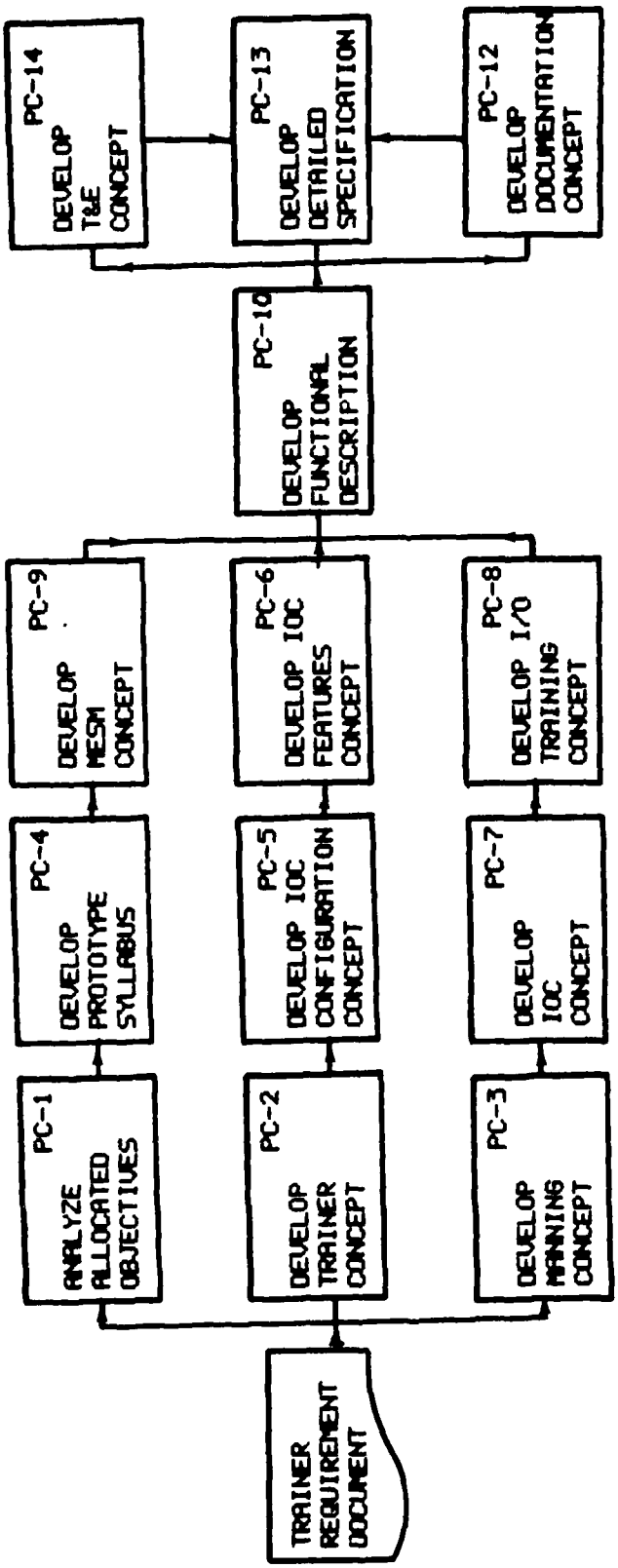


Figure 3. Pre-contract phase tasks

The top row of tasks is concerned primarily with the development of test or prototype syllabus based on the training objectives and with the identification of the trainer functional subsystem required to support training syllabus events or exercises.

The center row of tasks address the problem of identifying the IOS functional requirements including the configuration and the instructional and operational features.

The bottom row of tasks structure the IOS manning concept and I/O (instructor/operator) training concept for input to the functional description.

The precontract phase concludes with the development of the IOS functional specification and its translation into the IOS portion of the trainer specification.

The T&E (test and evaluation) and documentation tasks have been singled out for special attention because of their impact on IOS design validation and the I/O operator training program.

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3.2.1 Task PC-1. Analyze Allocated Tasks.

3.2.1.1 Objective: To ensure that specific behavioral objectives (SBOs) for the training device have been stated and to ensure that each objective is stated in behavioral terms with conditions and performance standards. The objectives should flow from the results of the overall weapon system task and training objectives analysis and training objectives allocation.

3.2.1.2 Description: Specific behavioral objectives for a trainer are those detailed learning objectives to be taught during the trainer phase of the syllabus. SBOs are developed at the detailed level of analysis and are stated as specific behaviors to be performed along with the conditions under which, and standards to which, they are to be performed. At the appropriate detailed level, the SBOs provide critical system design inputs to system specifications including the functional specification military characteristic and engineering specification. The FPT should assist in validating the objectives.

3.2.1.3 Inputs: The results of the media selection and syllabus development efforts completed as part of the weapon system training requirements analyses (TRA) are the required inputs. The Data Item Description (DID) documentation outlined in paragraph 3.1 above outlines the data required.

3.2.1.4 Actions: Verify the completeness and adequacy of the SBO data.

3.2.1.5 Outputs: The detailed training objectives allocated to the trainer are the outputs of the task. DID UDI-H-2571B Objectives Hierarchies Report, outlines typical data required.

3.2.1.6 Impact: Behavioral objectives data are essential to training device definition, especially for the IOS. Meaningful functional requirements, training objectives and syllabi cannot be developed without these data.

3.2.1.7 Contingency Tasks: If SBOs are not available from the weapon system training analysis, they must be generated by completing the required TRA effort, by extrapolation from similar training equipment or situations and requirements or through assumptions which can be subsequently verified. In any event, the following supporting data are needed:

a. Weapon system task analysis. The task analysis defines the knowledge and skills which the personnel must acquire to perform the job involved. From these data are extracted the total set of learning objectives for the trainer. At the minimum, those operational tasks most likely to be taught on the trainer must be analyzed so that trainer SBOs can be extracted. (See DIDs UDI-H-25713B and DI-H-7068 for guidance.)

b. Terminal Objectives Development. Terminal objectives are those learning objectives to be achieved by the student for completion of training. A subset of terminal objectives will have been allocated to the trainer as part of the media allocation process conducted during the weapons systems TRA process. These data along with other TRA data, constitute the design basis for training devices. At a minimum, a set of terminal objectives must be identified for the trainer since they are required to develop the military characteristic (MC). Creating training objectives by assumption or by extrapolation from similar systems is extremely risky and should not normally be attempted. (See DID UDI-H-25713B for guidance.)

c. Media Selection/Syllabus Development. Media selection and syllabus development are simultaneous and interactive processes which culminate in matching specified learning objectives with their respective projected training media. It is through these processes that learning objectives targeted for a specific simulator or other training device may be logically identified and defined. Syllabus data related to any piece of training hardware (media) are essential inputs to the development of the MC. Generation of these data without the required analyses will normally not produce instructionally sound media prescriptions or syllabi. (See DID UDI-H-25720B Media Selection and Syllabus Report, for guidance.)

3.3.2 Task: PC-2. Develop Trainer Concept.

3.2.2.1 Objective: To delineate and describe the projected uses of the trainer and identify personnel, resources and facility requirements involved. Data from the trainer program concept will eventually be input to the tasks defining the trainer's instructional functions and features which are a critical part of the trainer Military Characteristic (MC).

3.2.2.2 Description: The trainer program concept includes the projected training throughput, trainee input characteristics, assets required, media allocation, draft syllabi and related training system parameters. It is a subset of the overall weapon system training program concept/plan.

3.2.2.3 Inputs: The following inputs from the weapon system training requirements analyses are required:

a. weapon system training concept,

b. weapon system training assets analyses,

c. trainee characteristics (both qualitative and quantitative, i.e., throughput requirements).

DIDs UDI-H-25701B Problem Analysis Report, and UDI-H-2571B Student Entry Level Report, outline the type of data required as inputs.

3.2.2.4 Actions: Develop the trainer/training concept.

3.2.2.5 Outputs: A detailed training concept or plan which can be utilized to structure and develop preliminary syllabi, training support function requirements, training feature requirements (e.g., see Appendix D) and the facility configuration concept. DID UDI-H-25711B outlines the type of data required.

3.2.2.6 Impact: The training concept or plan which structures the trainer characteristics and forms the basis for the development of data critical to the formulation of the functional description and MC.

3.2.2.7 Contingency Tasks: To prevent arbitrary or biased design of the TOS, specific data must be provided as inputs to the development of the trainer/training program concept. It is essential that the following data be available (either from analysis, validated assumptions, or extrapolation from similar systems) as inputs for the concept/plan development.

a. Student training concept. The concept provides an overview of training program purposes and functions and defines the roles, responsibilities and function of the major training program elements. These data include the roles, responsibilities and functions of training devices within the total training system

and of the instructional and support personnel for each phase of training. Those aspects of the concept dealing with instructional and support personnel for trainer operations are of particular importance to the preparation of the MC.

b. Assets analysis. The assets analysis data describe the personnel, equipment and facilities available for the training program. The data form the resource constraints for the trainer and in particular the IOS. The data allow for realistic scoping of the training program including the suite of simulators and other training devices.

c. Throughput requirements analysis. Throughput requirements identify the number of trainees required to be processed by the training system per unit time. The data include not only the quantity but also trainee input characteristics in terms of experience and capabilities and the output characteristics in terms of job performance requirements. The data are used to scope the total training program in terms of training system performance objectives, manning and support requirements and training program contents.

The FPT can provide subject matter expertise and user inputs. They should be utilized extensively in completing any contingency tasks.

3.2.3 Task: PC-3. Develop Manning Concept.

3.2.3.1 Objective: To establish the trainer IOS manning philosophy and constraints and to provide a manning concept to guide IOS functional description. The data also provide a key input to the test and evaluation criteria for the IOS.

3.2.3.2 Description: The manning concept delineates the projected IOS manning policy for the trainer. The concept includes both quantitative and qualitative manning information. Unit and intra-unit turnover or rotation data is required and generally available in the weapon system manning data. The data are critical to the definition of performance characteristics and requirements for the IOS including numbers of stations required, training function support needs and training software support needs. The concept also includes preliminary job description data in terms of how the personnel are intended to function "on-line" during training exercises such as mode of training, location of instructor relative to the trainee, performance measurement and evaluation approach and data management concept.

3.2.3.3 Inputs: The following inputs are required:

a. results of the analysis of training assets/resources,

b. trainer training program concept,

c. total training program manning concept.

3.2.3.4 Actions: The following actions are required:

a. develop the trainer manning concept relative to the training assets and resources data,

b. verify that the concept is conceptually feasible.

DIDs UDI-H-25710B and DI-H-7066 outline the type of data required.

3.2.3.5 Outputs: A feasible trainer manning concept including quantitative and background characteristics of the instructor/operator personnel involved is output. Although of importance to the IOS design, maintenance design and manning is part of the Integrated Logistics Support Program (ILSP) and its implementation. Close coordination with the ILSP, especially where personnel are shared such as when an operator also performs maintenance is required.

3.2.3.6 Impact: The manning concept and constraint data are the most significant determinant of the IOS performance character istics and requirements. Defective manning concept data can therefore result in design deficiencies which significantly impact on supportability and trainer effectiveness. Explicit

data on manning constraints and objectives is critical to IOS functional definition and specification.

3.2.3.7 Contingency Tasks: Manning data must be stated prior to the development of the functional specifications. If the required analyses have not been completed, the data must be generated either by extrapolation from trainers with similar requirements and training objectives or by generating verifiable assumptions. It is essential that data from the following tasks be included or reviewed in the development of the manning concept. The DIDs identified in the preceding tasks can be used for guidance.

a. Trainer Program Concept. The trainer program concept must be developed at least to the point that the role and functions of the trainer relative to the overall training program can be established. This requires that the overall training program concept be available. The data must include estimates of trainer hours required for the syllabus relative to the throughput requirement.

b. Asset (Resources) Analysis. The assets analysis data describe the personnel, materials and facilities available for the system training program. The data form the baseline for identifying the assets available to the trainer and the IOS in particular.

c. Training Program Manning Concept/Constraints. Feasible allocations of personnel to man the IOS must be developed. If not directly available, the options must be structured from the overall training program concept and resource analysis data. Both quantitative and background data must be generated.

The FPT should be utilized for information to complete the contingency tasks including validation of the results.

3.2.4 Task: PC-4. Develop Test Syllabus.

3.2.4.1 Objective: To provide example training exercises and scenarios to serve as guidelines for trainer design and test and evaluation. They provide a means of exploring the training envelope by sampling demanding objectives. They provide a basic input to the instructor/operator task analyses and IOS functional description.

3.2.4.2 Description: The test or prototype syllabus is developed from the trainer SBOs and must reflect the overall weapon system training syllabus and training program concept. In addition to the SBOs, the syllabus delineates the non-behavioral parameters contained in the scenario such as sequence and timing of sub-events, duration and repetition of events and recording requirements.

3.2.4.3 Inputs: The following inputs are required:

a. Weapon system training requirements analysis data including:

o task analysis data including sequence and timing of tasks. The data from analyses such as operational sequence diagrams (OSDs) is particularly useful.

o training objectives.

o media selection/allocation data.

b. trainer usage data from the trainer program concept.

c. FPT developed preliminary syllabi and training event scenarios.

3.2.4.4 Actions: Develop/review the prototype syllabus to provide and determine that:

a. adequate mission and performance details are available to serve as guidelines for trainee station and IOS design,

b. adequate task information detail is available to develop IOS display functional requirements,

c. adequate training objectives data to generate instructional support requirements.

3.2.4.5 Outputs: A test syllabus and events which exercise the training envelope limits or most demanding instructional objectives, functions and features is output. The syllabus and events provide data for both the trainer functional description and the baseline for the test and evaluation requirements. DIDs UDI-H-25720B and DI-H-7069 Training Course/Curriculum Outlines, should be used for guidance.

3.2.4.6 Impact: A test syllabus and events/exercises are critical to the development of the training concept, the training features concept, instructor training concept and the test and evaluation concept.

3.2.4.7 Contingency Tasks: Although a temporary prototype syllabus may be generated by extrapolation from similar training systems and training requirements, any such syllabus must be validated against the explicit training objectives for the trainer prior to completion of the functional description and military characteristic.

3.2.5 Task PC-5. Develop IOS Configuration Concept.

3.2.5.1 Objective. To develop a feasible configuration concept for the trainer IOS including the stations and training spaces and their relationship to other trainer subsystems. The task provides the first opportunity to "lay-out" the facility.

3.2.5.2 Description: The facility configuration concept should include a functional layout of all spaces involved in the trainer concept. The arrangement and configuration of spaces to meet instructional functions is of prime importance. These include spaces for the IOS as well as for briefing and debriefing and for the trainer computer system console(s). Consideration should be given to traffic flow, privacy requirements, size, seating and workspace requirements as well as training implementation/coordination requirements.

3.2.5.3 Inputs. Two inputs are critical to the task. These are:

- o trainer concept,
- o manning concept.

The trainer concept inputs include the overall weapon system training concept, the results of the assets analysis and the results of the throughput analysis. The training concept provides sequencing and configuration data on the relation of the trainer to the overall training plan. The assets analysis provides general constraint data. The throughput analysis provides data on both the volume of trainees and the flow rates anticipated over time. Although the facility configuration concept is necessarily broad at this point, the early development of a facility configuration is important in the IOS development process to ensure that facility problems are considered as early as possible.

3.2.5.4 Actions. Develop a feasible facility configuration concept utilizing available data on the overall training plan and related constraint data such as throughput projections, envisioned assets and manning concept. Plan views should be developed and probable traffic flow patterns generated for instructors, operators, trainees and visitor personnel. Previous reviews of IOSs have repeatedly found serious problems resulting from such conditions as:

a. trainee access to the crew station involving walking through the instructor station area, often directly past the instructor displays and seating area.

b. visitors to the area walking directly into the area behind the instructors.

The physical relation of the projected facility to other system training facilities should also be developed. For ex-

ample, transportation, transit time and parking requirements need to be addressed.

3.2.5.5 Outputs. The output should include plan views of the facility concept along with a review of the requirements and problems which have been identified.

3.2.5.6 Impact. A feasible facility configuration concept is essential to the front-end analysis of the required trainer. Potential facility problems must be identified as early as possible. The IOS is one of the key components and the facility must be conceptualized to support the IOS and the training functions which will be implemented including the briefing and debriefing function. The relation of the instructor and operator personnel to the trainee station and brief/debrief stations must be considered. The outputs of the task are critical inputs to the IOS functional description. DID UDI-H-25727 Implementation Plan Report, outlines the type of data required.

3.2.5.7 Contingency Tasks. The training concept (Task PC-2) and the manning concept (Task PC-3) are required inputs. The outputs of these two tasks must be developed for input to the facility configuration concept task.

3.2.6 Task PC-6. Develop I/O Features Concept.

3.2.6.1 Objective: To identify the instructing and operating features concept for the trainer.

3.2.6.2 Description: The I/O features concept includes a list of instructional or training features and their characteristics for incorporation in the trainer. The features outlined in Appendix E should be used as a point of departure.

3.2.6.3 Inputs: Three inputs are essential to the identification of feasible and required instructional features. These are:

- o prototype syllabi and event/scenario descriptions,
- o trainer concept,
- o manning concept.

Each provides unique inputs. The prototype syllabi identify the training objectives and the training event characteristics to be implemented including the initialization and termination points. These data permit the conceptualization of event implementation requirements in terms of trainer features such as replay, reset, initialize and IC (initial conditions) modification as well as for programmable ICs and event evolutions. The trainer concept data provides feature requirements in terms of trainee entry level characteristics, training objectives and throughput goals. These data define the need for entry skill level demonstration/-testing features as well as for performance monitors and freeze requirements. Adaptive training features are partially governed by assets and throughput requirements. The manning concept data provides baseline data for automation and control and display requirements.

3.2.6.4 Actions: Conceptual instructional features must be developed. A top level job and task analysis based on the concepts developed must be completed and feasible allocations of tasks within the manning concept completed. Alternative feasible concepts should be developed and evaluated in terms of the conceptual syllabi, events and training concept. Basic system operating skill acquisition dictates different features than required for advanced tactical weapons system. In addition the manning concept along with the syllabi and training plan, dictate the training support or automation required in the features.

3.2.6.5 Outputs: A list and description of conceptual training or instructional features and their characteristics constitutes the output.

3.2.6.6 Impact: A preliminary list of feasible features which reflect the training concept, syllabi and manning concept are essential inputs to the development of the IOS and instructor/operator (I/O) training concepts. Neither a meaningful IOS concept

or I/O training plan can be developed without the features concept. They are critical to the development of the trainer description and functional specification.

3.2.6.7 Contingency Tasks. The preliminary or prototype syllabi with training objectives and the training and manning concepts are necessary inputs to the development of the instructional features. They must be developed prior to the analysis and definition of the OPS features concept.

3.2.7 Task PC-7. Develop IOS Concept.

3.2.7.1 Objective: To develop a feasible function and configuration concept for the IOS of the trainer.

3.2.7.2 Description: The IOS concept includes operational and layout characteristics based on the training plan, manning and I/O features concepts, training functions and the preliminary allocation of operating functions and tasks to the instructor/operator staff. The concept reflects the evaluation of alternatives developed and evaluated to the criteria contained in these concepts and the facility configuration concept.

3.2.7.3 Inputs: Data developed in the following tasks are required inputs: to this task:

- o trainer program concept,
- o facility configuration concept,
- o IOS features concept,
- o manning concept,
- o training function requirements (see Appendices A, C).

In addition, FPT inputs should be solicited and incorporated as reflecting user requirements and objectives.

The trainer program concept provides data on the weapon system training concept, assets, throughput and the general characteristics of the required trainer. The facility configuration concept provides data on the feasible arrangement of the trainer system including the IOS. The IOS features concept provides data on the interface requirements and station manning concept. The manning concept defines both the quantitative and qualitative requirements and constraints on the IOS station design. The training function requirements provide the basic training system requirements.

3.2.7.4 Actions: Develop alternative trainer instructor/operator station concepts in terms of layout and display/control content (in functional terms) and select an optimum concept in terms of requirements criteria. The layouts should reflect both the facility configuration concept as well as the manning concept and alternative allocations of the operating/training functions and tasks developed. The display and control functional requirements for each station based on the instructional features data and prototype syllabi are also developed. Alternative feasible concepts should be evaluated in terms of the input data as well as existing human factors criteria, training device standards and general specifications.

3.2.7.5 Outputs: The IOS concept is a functional description including a layout diagram of the selected alternative station based on requirements and capabilities inputs. In particular the station must be compatible with the manning concept and the instructional features and syllabi requirements. Since the overall process is generally iterative, the feasible alternative concepts should be documented and reconsidered in any subsequent reiterations. DID UDI-H-25718B - Trainer Functional Description Report outlines some typical data requirements.

3.2.7.6 Impact: The IOS concept is an essential input to the trainer functional description and to the instructor/operator training concept.

3.2.7.7 Contingency Tasks: The manning concept in terms of instructor and operator quantitative and qualitative characteristics and training function requirements are essential to the IOS concept development as are the data on the instructional features and overall syllabi implementation requirements data. In addition, the facility configuration data in terms of station location, size constraints and projected utilization (throughput) are needed.

3.2.8 Task PC-8. Develop Instructor/Operator Training Concept.

3.2.8.1 Objective: To develop the preliminary requirements for the training of the instructor and operator personnel identified during Task PC-3.

3.2.8.2 Description: The instructor/operator training concept is directed primarily to identifying the instructor/operator training objectives and constraints involved in the conceptual training system developed during the previous tasks. The concept includes delineating the projected length and content of the training required as well as the performance requirements. In addition, constraints on the training which reflect the manning concept in terms of turnover, refresher training requirements and length of course based on projected length of time on the job should be identified.

3.2.8.3 Inputs: Two inputs are required for the analysis. These are:

o IOS features concept including syllabus requirements and manning constraints and concept from task PC-4,

o IOS concept from task PC-5.

In addition, the FPT as user representatives, will provide data on operational training objectives and philosophy.

3.2.8.4 Actions: Develop the instructor and operator training program concept for input to the functional description document. Top level training objectives should be developed. The concept should include the quantitative and qualitative manning estimates and constraints, the projected performance requirements and the training program constraints including any limitations on assets or media including the device itself. The training program concept should reflect the requirements of all personnel projected to man the IOS.

3.2.8.5 Outputs: The output consists of an instructor/operator training program concept which includes training objectives, asset/media constraints and "trainee" characteristics in terms of entry skill levels. Performance objectives should be included. The same DIDs that apply to student/trainee training program development should be utilized for guidance.

3.2.8.6 Impact: Trained personnel to man the IOS are critical to the effective use of the trainer as well as to the operational test and evaluation of the trainer. The training program concept including requirements and constraints must be input to the functional description for the training requirements to be considered during the acquisition of the trainer. Operability problems have plagued many trainers which have failed to address the problem prior to the design and installation of the trainer.

3.2.8.7 Contingency Tasks: Syllabi, instructional and trainer features, manning concept and IOS concept are essential inputs for the development of the instructor/operator training program concept. They must be developed in order to develop the I/O training concept. The FPT can be utilized to provide key inputs to the contingency task.

3.2.9 Task PC-9. Develop Minimum Essential System Matrix (MESM) Concept

3.2.9.1 Objective: To identify the degraded trainer performance training requirements/capabilities.

3.2.9.2 Description. The MESM as defined in OPNAV Instruction 54421.4, identifies those systems/subsystems that provide an essential and unique capability to perform a specific mission/ objective whether it be in an aircraft or a trainer. Simulations of all weapon system subsystems are not required for all training exercises. For example, instrument flight training may not require that the visual system be operative; aircraft emergency procedures training may not require all of weapon subsystems simulation. The trainer MESM concept is based on the training objectives and prototype syllabus. It identifies the projected degraded training capabilities required of the trainer. MESM construction is described in Enclosure 8 to OPNAV Instruction 5442.4. A sample MESM is contained in Appendix E.

3.2.9.3 Inputs: Training requirements and specific behavioral objectives from task PC-1 and the prototype syllabi from Task PC-4 are required to develop the trainer MESM concept. The FPT as subject matter experts and user representatives will provide weapon system and related training functional and subsystem scenario related requirements.

3.2.9.4 Actions: Analyze the training requirements and the prototype syllabi and events to identify specific trainer subsystem simulations essential to meet the training objectives. A matrix of training objectives and required trainer capabilities to implement the training should then be developed. Where alternative configurations are feasible, a minimum set of capabilities should be selected. Each training event in the prototype syllabi should then be analyzed in terms of the minimum set of capabilities required to meet the objectives. Finally, an overall summary matrix of events and required capabilities should be developed.

3.2.9.5 Outputs: A matrix identifying the events in the prototype syllabi and the training capabilities (conceptual subsystems) is developed. It identifies the minimum set of trainer capabilities which must be functional to conduct and meet the specific requirements of each training objective and event.

3.2.9.6 Impact: Degraded training capability requirements must be based on training objectives and syllabi. Trainer effectiveness is directly related to degraded capability relative to the syllabi. MESMs developed after the trainer subsystem architecture is complete and based solely on hardware or software considerations will not produce an effective degraded capability. Therefore MESM requirements or objectives must be identified and input to the functional description to achieve a design which addresses degraded training mission requirements.

3.2.9.7 Contingency Task. The training requirements and the prototype syllabi and events are essential inputs. Therefore the outputs of task PC-1 and PC-4 are required. The FPT should be utilized not only to assist in developing the missing data, but also to validate the results in terms of operational requirements.

3.2.10 Task PC-10. Develop IOS Functional Description.

3.2.10.1 Objective: To develop and provide IOS functional requirements for the trainer Military Characteristic (MC).

3.2.10.2 Description: All of the requirements and conceptual data generated in the previous nine tasks are merged and structured in terms of IOS functional requirements for incorporation in the training device MC. The latter document forms the basis for the trainer performance specification. Thus the IOS functional requirements represent the first formal input of the IOS analyses into the trainer requirement development process.

3.2.10.3 Inputs: The primary inputs to the IOS functional description are the following:

- o MESM requirements,
- o instructor/operator training concept,
- o IOS concept,
- o facility configuration concept,
- o training requirements.

These inputs reflect the outputs of other tasks whose inputs are critical such as the trainer concept, the manning concept, prototype syllabi and instructional features.

3.2.10.4 Actions: Translate all of the requirements and conceptual data developed in the previous Pre-contract Phase tasks into functional terms for input to the trainer functional description. The function descriptions define "how" the trainer will meet the requirements within the concept and constraints identified.

Functional statements are generally developed in a hierarchical manner beginning with the gross functions required to meet the requirements and being expended at succeeding levels until they form a framework for the development of a trainer functional description or specification. The function reduction process must stop before allocation of function to man or "machine" becomes essential or implicit. Trainer functional statement and specification formats are outlined in NAVTRAEQUIPCEN Instruction 3910.4 "Preparation of Military Characteristics."

3.2.10.5 Output: IOS functional description data for input to the trainer MC are developed. The output should identify not only the IOS requirements but also the functional area identified and the interfaces with other trainer/training "modules" or subsystems involved. DID UDI-H-25718B - Trainer Functional Description Report, outlines typical data required.

3.2.10.6 Impact: The IOS functional description and requirements are an essential part of the trainer Military Characteristic.
3.2.10.7 Contingency Tasks: The output data from the following tasks are required:

- o Task PC-5 Develop Facility Configuration Concept,
- o Task PC-7 Develop IOS Concept,
- o Task PC-8 Develop Instructor/Operator Training Concept,
- o Task PC-9 Develop MESM Concept.

The outputs must be developed by completing the tasks involved. Where time does not permit the completion of the tasks prior to the development of the IOS functional description, the inputs must be developed either by extrapolation from similar trainers or through assumptions. In either case, the results must be validated prior to initiating the design tasks. The FPT should be utilized extensively in developing the required data and validating the results.

3.2.11 Task PC-11. Develop IOS Test and Evaluation (T&E) Concept.

3.2.11.1 Objective: To develop T&E criteria and a testing and evaluation plan.

3.2.11.2 Description: A testing concept for the IOS utilizing the criteria developed is an essential input to the Military Characteristic (MC) and to the detailed specification. The plan includes defining the test and evaluation approach and proposed design. Plans for testing to establish both compliance with the specification and operational suitability is involved. The conceptual plan includes identification of test conditions, criteria, "subjects" and design and data reduction/ analysis plans.

3.2.11.3 Inputs: The major inputs to the task are the IOS Functional Description and the MESM requirements data. However, these inputs reflect the background tasks including the training objectives and related performance criteria, the prototype syllabi, the manning concept, the facility configuration concept, the IOS features concept, the user training concept and the IOS concept. The FPT will assist in both defining the concept and developing criteria related to operational training.

3.2.11.4 Actions: Develop an IOS T&E conceptual plan which exercises all of the requirements and concepts developed. An effective test plan must be established on the basis of the requirements, not on the basis of the eventual design.

3.2.11.5 Outputs: A testing concept which identifies the test objectives and the test conditions (including trainee and instructor/operator personnel) across the spectrum of training events for the test syllabi must be developed. The concept includes the test design and the data reduction, performance criteria and contingency plans for handling missing data and aborted test trials.

3.2.11.6 Impact: The T&E concept for the IOS is one of the most important inputs to the MC and performance specification. It provides the only direct means of evaluating the end product in terms of the user needs. It is also a unique guide for the trainer developer in terms of functional objectives.

3.2.11.7 Contingency Tasks: All of the IOS functional performance requirements are necessary inputs to the IOS T&E concept. Therefore all of the outputs of the preceding tasks which identify operational performance objectives are required for the development of the T&E concept. In the absence of definitive and quantitative data, assumptions and extrapolations from related or similar trainers must be relied upon but again must be validated prior to actual testing. The IOS test concept must be input to the trainer MC and performance specification.

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3.2.12 Task PC-12. Develop IOS Documentation Concept.

3.2.12.1 Objective: To develop the IOS documentation concept including operation and maintenance manuals, training manuals and materials and related engineering design data.

3.2.12.2 Description: System description, system operation, and system maintenance documentation and I/O training materials are required deliverables with the IOS. The overall strategy for the documents in terms of the objectives, the user, the interrelations of the documents and their technical content must be developed for input to the detailed specification and procurement package.

3.2.12.3 Inputs: The IOS functional description and the IOS concept are the basic inputs required. However these inputs include critical data from earlier tasks which is required including the instructor/operator training concept, the instruction features and the prototype syllabi and events.

3.2.12.4 Action: Identify the documents (and formats) required to meet the functional objectives including the training concept and manning concept. The set of documents identified must meet the user objectives identified in the previous tasks in terms of data requirements and user qualifications and characteristics including readability requirements. The documents should reflect the different levels and locations for use such as the I/O training classroom, IOS or technical library. The FPT will be a major source of data and should assist in developing the concept and validating it against the operational needs.

3.2.12.5 Outputs: The output consists of a functional description of the documentation strategy including the numbers of different documents required, the intended user in terms of reading and comprehension level and background experience including related training, the location of use and the basic structure of the manuals/documents related to the overall concept.

3.2.12.6 Impact: Trainer manuals and documents are essential to the training and operation of the trainer, especially for the personnel manning the IOS. The documents must be designed to meet the various requirements from instructor and operator training to an IOS "guide" or check-list to technical or engineering reference material. No single document can meet all of the needs. Therefore it is essential that an overall strategy of documentation to meet the requirements be developed and provided as guidance for the development of the trainer specification and procurement package.

3.2.12.7 Contingency Tasks: Although the documentation strategy is based on most of the early analyses including the training concept and requirement, the critical inputs to development of the documentation concept which must be input to the task are:

o the manning concept in terms of numbers and type of personnel who will operate the device during training. The data proscribe the characteristics of the documentation required in terms of content, format, construction and readability. In addition, the data identify the training materials required.

o the instructor/operator training concept in terms of media and approach. These data further identify the content of the documentation required for training purposes and also for IOS reference purposes.

o the IOS features concept which defines the software and hardware support which will be provided the instructor/operators and the extent of training which must be provided.

o the prototype syllabi and events which in large determine the extent of the instructor's task.

Again, the FPT will be a major source of data and assistance in completing the contingency tasks.

3.2.13 Task PC-13. Develop IOS Performance Specification.

3.2.13.1 Objective: To translate the IOS Military Characteristic and functional requirements data into specification format for the procurement of the trainer.

3.2.13.2 Description: The end product of the pre-contract phase of the trainer acquisition process is the detailed statement of the requirement in performance terms for subsequent use in the design and implementation of the IOS. The trainer performance specification forms the primary guidance to the trainer developer.

3.2.13.3 Inputs: Four inputs are essential to the development of the trainer IOS performance specification.

- o the IOS T&E concept,
- o the IOS performance requirements,
- o the IOS configuration concept,
- o the documentation requirements.

3.2.13.4 Action: Develop the IOS subsystem performance specification data and provide related inputs to the development of other parts of the trainer specification, especially in terms of documentation and facility configuration related to the IOS. The IOS specification is a performance type of specification which is based on the functional requirements identified in the preceding tasks and includes interface requirements with other trainer functions and subsystems.

3.2.13.5 Outputs: A subsystem specification for the IOS is the output of the task. The specification must be compatible with the overall trainer specification including interface specifications.

3.2.13.6 Impact: The IOS performance specification is the culmination of the Pre-contract phase efforts and provides the IOS input requirements to the trainer specification. A meaningful trainer specification requires related IOS performance requirements and characteristics. Thus, the IOS subsystem specification represents a critical document in the pre-contract phase of a trainer procurement.

3.2.13.7 Contingency Tasks: The IOS subsystem specification is an essential part of the overall trainer specification which is required for trainer procurement. The specification cannot be developed without the background and supporting analyses and data. Therefore, if the pre-contract tasks have not been completed prior to the initiation of the trainer specification development, the following minimum data must be developed either through extrapolation from similar trainer requirements or through reason-

able assumptions and related analysis. In either case, the results must be validated as soon as possible and prior to the trainer acquisition critical design review, approval of the configuration report or the design freeze, whichever occurs first.

o manning concept in terms of numbers and skills of instructor and operator personnel,

o instructor/operator training constraints in terms of duration and content of the course including refresh and update requirements,

o training objectives including performance criteria,

o test syllabi and training events reflecting the training requirements, the overall system training concept, the throughput requirements and the interaction with other media and assets,

o the minimum training and operating features set which is compatible with the manning and instructor/operator constraints the training objectives and the training concept including prototype syllabi,

o training functions implementation concept.

The data must be analyzed for internal consistency prior to being utilized for the development of the IOS subsystem specification.

SECTION IV

IOS ACQUISITION PHASE TASKS

4.1 GENERAL. The IOS related acquisition phase tasks are outlined in Figure 4. The tasks are depicted in a generic flowchart. The detailed flow may vary for any specific IOS development effort. The flow begins with the first task in the development effort and is based on and utilizes the data developed in the pre-contract phase.

The tasks defined are the responsibility of the Training Device Development and Acquisition Activity (TDD/AA) as defined in OPNAV Instruction 1551.7, and in particular, the training/human factors technical monitor for the project. They also provide guidance to the trainer developer in so far as the tasks identify data and results which will be evaluated by the TDD/AA.

4.2 ACQUISITION PHASE TASKS. The same task outline utilized for the pre-contract phase will be employed in describing the acquisition phase tasks, i.e., each of the tasks outlined in Figure 4 will described in detail in terms of objective, general description, task inputs, actions required, task outputs, the impact on the IOS acquisition phase and the contingency tasks and subtasks which must be performed if the requisite data is not available for input to the task. The Fleet Project Team for the trainer should be utilized both as subject matter experts and as representatives of the ultimate user.

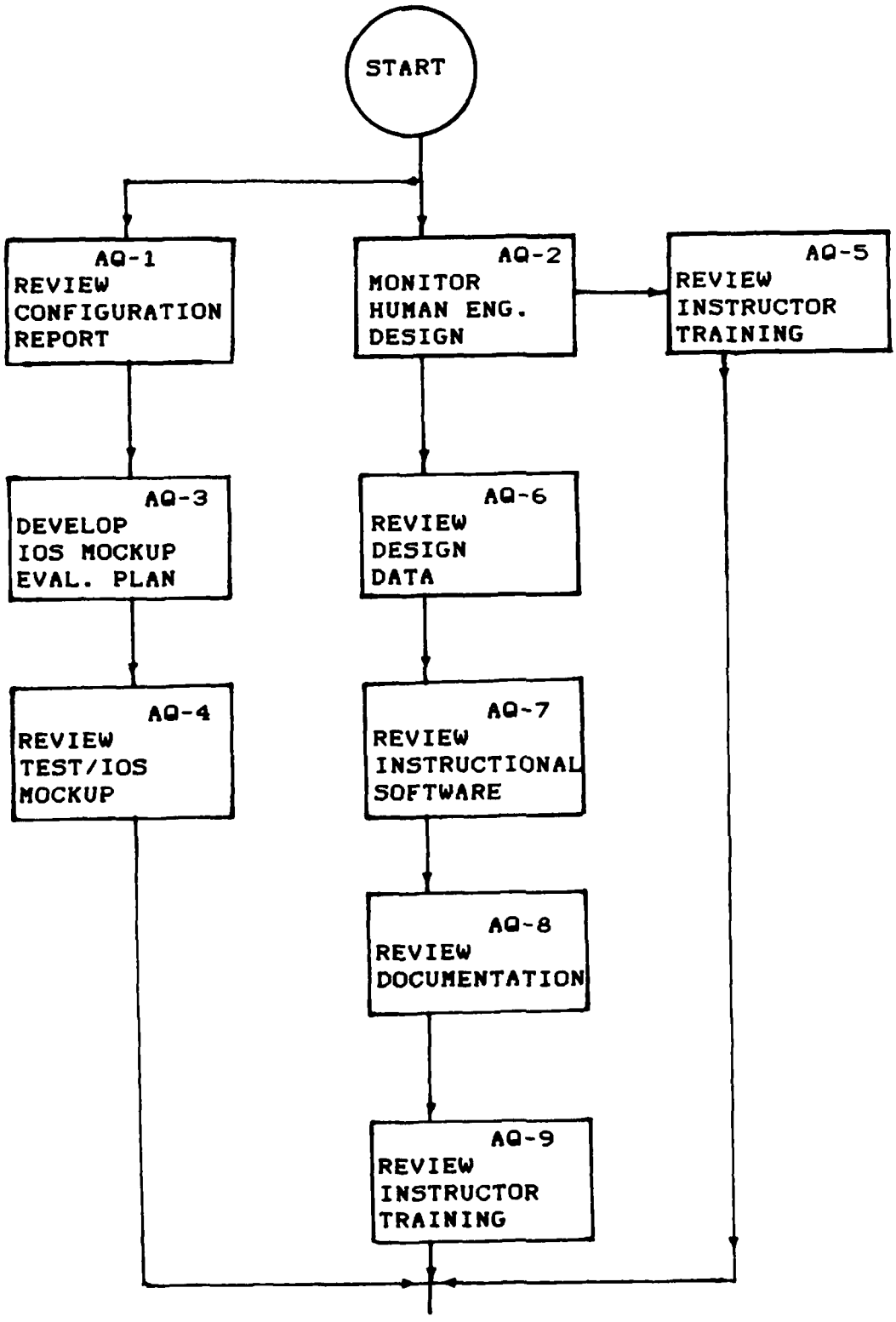

Figure 4. Acquisition phase tasks (page 1 of 2)

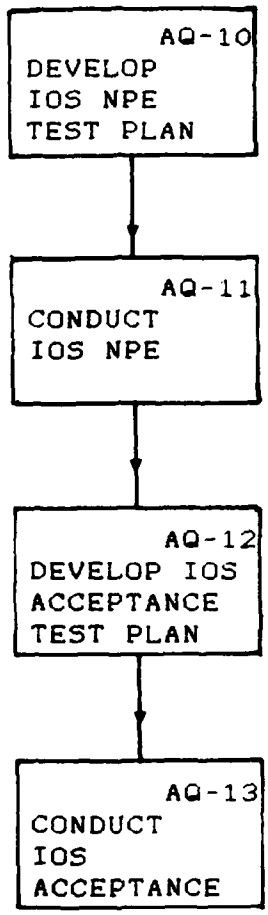

Figure 4. Acquisition phase tasks (page 2 of 2)

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4.2.1 Task AQ-1. Review Configuration Report.

4.2.1.1 Objective: Verify that the design configuration meets the requirements and concepts developed in the Training Requirements Analysis (TRA), the Military Characteristics (MC) and the trainer performance specification. These include the training concept, manning concept, facility concept and instructor/ operator (I/O) features concept.

4.2.1.2 Description: The configuration report is normally the first design report delivered and sets the foundation for the trainer mockup and subsequent configuration and related design freeze. The report typically includes detailed configuration and arrangement data for the device including subsystems location and detailed instructor and operator station display and control configuration. The report is finalized after the mockup is approved.

4.2.1.3 Inputs: The following inputs are required for the development and review of the configuration report:

a. performance specification and background data including:

o manning concept,

o configuration concept,

o training objectives,

o training function support requirements,

o I/O features requirements,

o test syllabus,

o prototype training scenarios and events.

b. preliminary training operations analysis,

c. human factors design specifications, standards and criteria,

d. FPT review of the report.

4.2.1.4 Actions: Review the Preliminary Configuration Report to establish that the:

a. proposed configuration is compatible with the training system concepts and constraints,

b. required analyses and rationale to support the proposed configuration have been conducted,

c. the proposed configuration is in compliance with human factors engineering specifications, standards and criteria related crewstation design practices.

4.2.1.5 Outputs: Critical review of the report including required changes and modifications to the proposed configuration and any required analyses or rationale to justify the design.

4.2.1.6 Impact: Any missing or defective input data necessarily results in arbitrary configuration decisions. These generally result in decreased trainer effectiveness and create operability problems, often to the point of requiring costly IOS design changes and or costly changes to the manning requirements.

4.2.1.7 Contingency Tasks: To preclude arbitrary design of the IOS, the data inputs to the task must be developed if not available. If the analyses required to develop the data have not been conducted or completed, the data must be developed either through assumptions or by extrapolation from data for other trainers with similar objectives and requirements and subsequently validated. It is essential that the following data be specified and input to the configuration design and report review.

a. Manning concept. The data include the characteristics of the instructors and operators, numbers of personnel, operating position (e.g., on platform or at an isolated IOS), student monitoring approach, (e.g., over-the-shoulder or from console repeaters/displays), trainer operational support (e.g., technician, mission operator, fully automated), and user qualifications and training constraints.

b. Configuration Concept. These data include the location and arrangement of the IOS relative to the crewstation/student station(s) the overall facility, the planned training operations in terms of functions such as brief and debrief, area "traffic flow", lighting, and subsystems support including hardcopy and computer system operations and technician support.

c. Training Objectives. Training objectives data must be available to at least the task level to successfully review the configuration report. Where the required analyses have not been completed, the objectives must be isolated through first and second level mission/function analysis and then structured to permit the statement of trainer training objectives. These must include the mission phases to be supported and the operational envelope involved, the crew interactions involved, the basic crew tasks and performance level/criteria involved and the trainee input skills.

d. Function Support. The definition of the support function is essential to the configuration review. In particular, the requirements for brief, debrief, scenario/event programming, instructor training, instructorless training, and training manage

ment support must be identified either through analysis, assumptions or similarity to other training systems.

e. Features. Training and operating features, manning concept, training objectives and training functions configuration requirements and support all interact. The configuration report outlines the station configuration in terms of control panels. Displays dictated by and compatible with these requirements must be isolated to ensure that no major "disconnects" exist and that the projected training operations approach can be implemented. Where the features requirements data do not exist, comparisons with similar training systems (in terms of training approach, objectives, functions and manning) and/or extrapolations from such systems must be utilized to develop the data.

f. Test Syllabus. A test or prototype syllabus is critical to review of the configuration proposed. If not available, a syllabus to permit evaluation of the IOS proposed, it must be developed or structured from similar training systems and weapon systems training programs.

g. Prototype Training Scenarios. Prototype scenarios and event descriptions are required to permit evaluation of the configuration proposed. The scenarios should present the most difficult training case conditions. Time sequence data such as developed in Operational Sequence Diagrams (OSD) or time line action/decision flow diagrams are necessary to establish completion time feasibility.

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4.2.2 Task AQ-2. Evaluate Human Engineering.

4.2.2.1 Objective: To evaluate the human engineering analysis of the IOS and training system interfaces to ensure compliance with standards, criteria and accepted practices including crew station design criteria and practices.

4.2.2.2 Description: Military Specification "Human Engineering Requirements for Military Systems, Equipment and Facilities" (MIL-H-46855B) is applied to all training device procurements. It outlines the human engineering effort and is directly applicable to the design and development of the IOS. Paragraphs 3.2.1 "Analysis", 3.2.2 "Human Engineering in Equipment Detail Design" and 3.2.3 "Human Engineering in Test and Evaluation" are particularly important to the station design and development. The results of these analyses should be incorporated in the Preliminary Configuration Report. They must be available prior to the review of the mockup and prior to the approval of the Configuration Report. The analyses should be updated during the design and development effort to reflect design changes and any new relevant design data.

4.2.2.3 Inputs: The following inputs are applicable to the Human Engineering Review:

a. trainer performance specification,

b. TRA data including:

- o manning concept
- o training objectives
- o test syllabus
- o sample training scenarios
- o training functions support requirements
- o I/O feature requirements
- o configuration and arrangement concept
- o instructor/operator training modes and roles

c. statement of work.

4.2.2.4 Action: Review the human engineering data submitted in accordance with MIL-H-46855 applicable to the IOS. Of particular importance is the review of data submitted prior to the mockup which must include:

a. the training mission analysis from a baseline scenario (test syllabus and sample training scenarios),

b. the analysis and allocation of functions to the IOS,

c. equipment selection rationale and human engineering criteria compatibility,

d. the analysis of instructor/operator tasks and workload,

e. the preliminary system and equipment detail design data including panel, control and display formats, arrangement and configuration.

4.2.2.5 Outputs: Required change recommendations and eventual approval of the human engineering design data for the IOS.

4.2.2.6 Impact: The human engineering of the IOS is essential to the design of an effective, efficient and user acceptable work-station. It is particularly critical to the design of interfaces in which the user is operating other related sub-systems (e.g., the weapon system) as part of his overall instructor/ operator job. The latter requires detailed consideration of negative skill transfer possibilities and interfering task requirements.

4.2.2.7 Contingency Tasks: Since the human engineering of the IOS is essential to preclude serious functional and operability problems, the following analyses and data must be generated for evaluation of the configuration and arrangement and for review and approval of the Preliminary Configuration Report and the Mockup Review.

a. instructor/operator training function flow analysis,

b. instructor/operator decision-action flow analysis,

c. instructor/operator training system function allocation, (implicit in the preliminary design),

d. instructor/operator task time-line flow and workload analysis,

e. information display and IOS control requirements analysis,

f. IOS detail equipment human engineering analysis to MIL STD 1472 and related aircrew station criteria/practices.

4.2.3 Task AQ-3. Develop IOS Mockup Evaluation Plan.

4.2.3.1 Objective: Define and develop a plan to conduct the review and evaluation of the mockup(s) of the IOS, the brief/debrief stations and the scenarios/exercise development console in conjunction with the trainer Mockup Review.

4.2.3.2 Description: The mockup is a three-dimensional model of the trainer including brief/debrief stations and user programming consoles which permits evaluation of the functional arrangement and design characteristics of equipment, components, displays, controls and furnishings in terms of operability, functional suitability, training suitability, human engineering and overall efficiency and effectiveness. A detailed test plan is required to ensure an objective and training oriented evaluation of the IOS mockup.

4.2.3.3 Inputs: The following inputs are essential to the development of the IOS mockup evaluation plan.

a. device performance specification,

b. Preliminary Configuration Report and review results, in particular, the human factors analyses and the configuration and arrangement data rationale,

c. evaluation plan and criteria outlined in the statement of work as it applies to the IOS, brief/debrief stations and programming exercise/scenario development console.

4.2.3.4 Action: Develop the mockup review and evaluation plan. The plan should include tests to verify operability relative to the training objectives, manning, instructor/operator training, training functions and instructing/operating features concept and requirements in addition to compliance with human factors standards and criteria and trainer specifications and standards. The plan should be coordinated with the FPT to ensure operational user inputs.

4.2.3.5 Outputs: A detailed mockup evaluation and validation plan is output for application at the pre-mockup and mock-up review meetings. Pre-mockup evaluation should include any lengthy tests or demonstrations requiring the mockup, especially where the results are needed as inputs to the mockup review.

4.2.3.6 Impact: The IOS and related brief/debrief station(s) and programming consoles must be objectively evaluated prior to the design freeze. Without an objective testing plan, they will necessarily be evaluated in terms of technology applications and will be subjective and experiential in nature. It is crucial that the mockup(s) be utilized to demonstrate that test and prototype training events and scenarios can be implemented to operational criteria.

4.2.3.7 Contingency Tasks: There are no contingency tasks or plans possible. A rigorous and objective IOS mockup evaluation plan is required.

4.2.4 Task: AQ-4. Review/Test IOS Mockup.

4.2.4.1 Objective: Validate that the mockup(s) reflect the Configuration Report and verify that the IOS including the brief/debrief station(s) and programming console are operable (within the mockup constraints) to meet the training objectives and plan developed.

4.2.4.2 Description: The mockup review involves the evaluation of a full scale three dimensional but (usually non-functional) model of the trainer including the IOS. It is utilized to review and validate that the proposed layout and design is feasible and meets the objectives of the specification and configuration report. The mockup occurs after the preliminary review of the Configuration Report.

4.2.4.3 Inputs: The following inputs are essential to the mockup review of the IOS and associated stations:

- o IOS mockup(s) review plan including:
  - test training scenarios and syllabi,
  - functions, features, and manning criteria,
- o review of the Preliminary Configuration Report,
- o human factors engineering analysis of the IOS.

4.2.4.4 Actions: In accordance with NAVTRAEQUIPCEN Instruction 1551.8, implement the mockup review test plan and validate and verify the results of the Configuration Report review. The instruction outlines the scope and procedures for conducting the mockup review of training devices. A preview analysis of the mockup should be conducted utilizing representative personnel to man the stations and to exercise the test scenarios and syllabi to reduce review time at the formal mockup review. Simulation of training evolutions will be required. FPT participation will be essential to provide valid operational inputs.

4.2.4.5 Output: Required changes and approval of the mockup as it relates to the design and development of the IOS.

4.2.4.6 Impact: Approval of the mockup is tantamount to freezing the physical design of the IOS, the brief/debrief stations and the programming console and their relation to the trainee station(s) and overall configuration of the trainer complex. In addition, control panel arrangements, labeling, and controls as well as displays (in so far as they are depicted at the mockup) will be frozen, i.e., will require a contractual change order to alter the design presented (as modified by mockup changes). The mockup(s) also becomes the contractor's baseline for further design.

4.2.4.7 Contingency Tasks: The following data must be available for the mockup review:

a. test training events and demonstration plan which exercise the instructor/operator actions required at the IOS in support of operational training. The events must not be developed on the basis of the IOS design features,

b. a human engineering analysis of the IOS and related instructor stations such as the debrief station. The analysis should document all discrepancies relative to human engineering standards and criteria,

c. training and operating features which are required,

d. training functions to be supported,

e. training concept including manning and training approach.

4.2.5 Task AQ-5. Monitor Human Engineering Design.

4.2.5.1 Objective: To insure that the human engineering program is meeting the requirements and providing the data required for the design of the IOS.

4.2.5.2 Description: MIL-H-46855 requires the development of a Human Engineering Program Plan which includes the tasks to be performed, milestones, level of effort, methods, design concepts, test and evaluation program and the integration of the effort into the total project. This task is concerned with monitoring the overall human engineering program in the design, development and test of the IOS.

4.2.5.3 Inputs: The following inputs are applicable to monitoring the Human Engineering Program:

a. trainer performance specification,

b. Statement of Work (SOW),

c. Contract Data Requirements List (CDRL),

d. Human Engineering Program Plan,

e. MIL-H-45855.

4.2.5.4 Action: Monitor the efforts undertaken in terms of schedule, quality and compliance with specifications.

4.2.5.5 Outputs: Approval of human engineering data.

4.2.5.6 Impact: Human engineering analyses and data must be completed and input on a timely basis to impact the IOS design. Inadequate or late efforts will not meet the design requirements.

4.2.5.7 Contingency Tasks: The human engineering program is normally a contractor responsibility. Where the tasks have not been incorporated in that effort or where they will not be delivered as needed, the monitor must input the critical data items either from assumptions, similarity with other systems or by developing the required human engineering data as best possible with the appropriate caveats. Design delays to accommodate late data development is an alternative if feasible.

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4.2.6 Task AQ-6. Review Design Data.

4.2.6.1 Objectives: To review and approve IOS design data submitted during the development of the trainer in accordance with the Contract Data Requirements List (CDRL) and specifications. A sample of a trainer CDRL is contained in Appendix F.

4.2.6.2 Description: The CDRL identifies the data to be provided during the design and development of the trainer. The data requires critical review and release or approval for use in design. Some of the data are unique to the IOS and are the responsibility of the IOS sub-system monitor; other data interact with other trainer subsystems and require multiple reviews and concurrences before final release for incorporating in the design.

4.2.6.3 Inputs: The primary inputs are:

a. contractor developed reports, drawings, etc.,

b. the DIDs (Data Item Descriptions) or specifications which identify the requirements,

c. the CDRL (Contract Data Requirements List).

4.2.6.4 Action: Review an evaluate the design data submitted to verify compliance with the requirements, the validity of the analysis and the consistency of data in terms of related data and analyses.

4.2.6.5 Outputs: Acceptance and approval of data for use in the IOS design.

4.2.6.6 Impact: Design data provides the information on which to base development decisions and to control the detailed design of the system. The IOS is the key subsystem of the training device since it not only provides the training functional control for the device, but it is the user interface with the system. Thus defective design directly impacts on training effectiveness both in terms of training effectiveness and in terms of operability. Therefore, the required design data must be reviewed in terms of the relevant criteria and released for design purposes only when it meets the requirements specified.

4.2.6.7 Contingency Tasks. There are no effective fall-back tasks. The data must be developed by the designer/developer. Implementation must not be permitted to continue until the required supporting data, whether it be analysis, rationale or detailed design documentation has been submitted and approved.

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4.2.7 Task AQ-7. Review Instructional Software.

4.2.7.1 Objective: To review and approve the content and user interface to instructional or training software (as opposed to simulation software).

4.2.7.2 Description: Instructional software is that computer software which supports the instructor/operator in the utilization of the trainer in implementation of training. It therefore consists of that software which provides the interface between the instructor/operator and the simulations incorporated in the trainer and the software which supports instruction or training as such including performance measurement/evaluation, procedures monitoring, reset/replay and demonstration. Three general functions are involved, namely:

a. trainer operating functions - those I/O functions related to trainer system and subsystem operation for student training including such features as scenario initialization/modification, malfunction/emergency insertion/removal, tactical environment control, models (e.g., enemy platforms, controllers) and hard copy.

b. trainer instructing functions - those functions related to utilizing the trainer as an instructional media and supporting the I/O including such features as automated and/or adaptive training, performance measurement/evaluation, procedures monitoring, freeze/reset/replay, demonstration, and brief/debrief.

c. trainer management functions - those functions related to managing the trainer as a training media such as maintaining student and instructor records related to the trainer, developing training scenarios and modifying/updating the syllabus and MESM.

4.2.7.3 Inputs: The following inputs are required for the task:

a. training/operating features requirements,

b. training functions support requirements,

c. manning constraints including user characteristics and requirements,

d. training syllabi and scenarios,

e. human engineering analyses of IOS including operations analysis and display/control analyses.

4.2.7.4 Actions: Critically review the proposed implementation of the training/instructional software. This includes verifying that:

o the architecture of the software is compatible with the

manning concept and the instructor/operator requirements and capabilities both in training modes and in modification/update modes,

o that the software provides for the display and control required,

o that it is user "friendly," i.e., that operable features are provided which implement functional requirements within the user's capabilities and characteristics and within user training and time constraints.

4.2.7.5 Output: Required changes and/or approval of the software design and documentation.

4.2.7.6 Impact: The training and instructional software is the major determinant of the effectiveness of the trainer both in terms of training capability and in terms of usability/operability. Therefore, it is of critical importance to verify that the training/instructional software will fulfill the requirements.

4.2.7.7 Contingency Tasks: The inputs identified in paragraph 4.2.7.3 are critical to the task and must be developed prior to conducting the task.

4.2.8 Task AQ-8. Review IOS Documentation.

4.2.8.1 Objective: To critically review and approve IOS documentation including engineering and operation publications.

4.2.8.2 Description: The developer is required to provide a set of documents describing the IOS and its operation. The documents are normally included in the CDRL. However, because of their importance to training operations, IOS publications are addressed separately. The documents provide data related to:

a. training in IOS operation and maintenance,

b. IOS maintenance,

c. IOS operation.

The format and content of the publications must be reviewed and approved in terms of the different user and end requirements.

4.2.8.3 Inputs: The following inputs are required.

a. CDRL,

b. DIDs,

c. contractor publications plan,

d. IOS tasks and skills analyses,

e. trainer engineering reports,

f. trainer operation analysis,

g user population reading level data.

4.2.8.4 Actions: Review the format, content and readability of the documentation to be delivered regarding IOS, brief/debrief station and programming console operation, maintenance and user training. Confirm that the documentation meets the documentation strategy specified. Validate and verify the contents. FPT inputs should be requested.

4.2.8.5 Outputs: The typical outputs include approval of the following documents and publications relevant to the IOS:

a. description and characteristics documents,

b. operation and utilization manuals,

c. programming manuals,

d. maintenance manuals,

e. check-out and test manuals,

f. training manuals.

4.2.8.6 Impact: The technical and training documentation delivered must meet the requirements of the instructor/operator and IOS maintainer in terms of both training and operating needs. The documentation provides the Navy the reference material to operate and support the IOS during its life cycle in terms of training operations, instructor/operator training, and checkout and trouble-shooting.

4.2.8.7 Contingency Tasks: Two inputs are critical to the development of the IOS documents. The first identifies the type of documentation required and flows from an analysis of the manning and training concept and the task, skills and operations analysis of the trainer. The general format for documentation, e.g., content, size, construction, must be developed to preclude the development of unusable manuals. The second identifies the detailed format for the manuals and reflects the user's entry level experience, skills and knowledge.

4.2.9 Task AQ-9. Review Instructor Training Plan.

4.2.9.1 Objective: To ensure that the initial cadre of instructors and operators will be trained in the operation and utilization of the trainer and that the plan is documented and will be usable by the Navy for instructor and operator training.

4.2.9.2 Description: The Training Plan is required on all training device procurements. It identifies the proposed schedule and courses to provide training for Navy personnel in the operation and maintenance of the device, including personnel for trainer tests and evaluations. The plan includes a list of the training courses and training materials required, an outline of each course and course management and administration information including instructor qualifications and training.

4.2.9.3 Inputs: The following inputs are required relative to the instructor/operator training:

a. IOS task and skills analysis,

b. instructor/operator training objectives,

c. IOS manning concept including instructor entry experience, skills and capabilities requirements,

d. training approach which will be implemented,

e. personnel scheduling and turnover constraints.

f. performance criteria for I/O trainees.

4.2.9.4 Action: Review the training plan to ensure that:

a. the plan will provide the training required for instructors and operators for both test and evaluations and initial operational training,

b. the plan is compatible with Navy training philosophy and the implementation constraints, especially personnel availability and entry characteristics,

c. criteria are included to evaluate and establish proficiency,

d. trained personnel will be available to meet test and evaluation schedules and trainer introduction,

e. training material requirements are defined and compatible with the training plan and milestones.

4.2.9.5 Outputs: A detailed training plan identifying the course and training management plan involved.

4.2.9.6 Impact: Trained personnel must be available to conduct both the test and evaluations of the training device and the introduction of the trainer. The training plan and its implementation are therefore essential. The plan must be compatible with the availability of Navy instructor and operator personnel, the IOS tasks, and the test plan. The training plan must provide a means of assessing instructor/operator proficiency to define a base line for trainer test and evaluation.

4.2.9.7 Contingency Tasks: The training plan and its implementation in terms of instructor/operator personnel are so essential to the trainer test and evaluation program that the inputs identified above must be available prior to reviewing the plan. (They must also be utilized by the developer in preparing the plan.) Since the test and evaluation of the trainer includes assessment of operability as well as training effectiveness, the skill level of the instructor/operators must be known prior to conducting the tests to reach valid conclusions. The following minimum set of data must be created and available for this task.

a. instructor/operator personnel characteristics in terms of training and weapon system experience, availability for training, and projected role in trainer test and evaluation, especially in NPEs and acceptance tests,

b. projected Navy instructor/operator manning and trainer introduction,

c. trainer utilization plan in terms of syllabus events,

d. training philosophy to be implemented in terms of instructor role and instructional features and instructional software,

e. IOS operating tasks and functions,

f. instructor/operator baseline operating skill level and means of establishing skill level, i.e., performance criteria and measurement techniques.

If these data are not and cannot be made available when required, extrapolation from similar trainers and training programs along with required explicit statement of assumptions must be created with the understanding that the results will be valid only to the extent that the assumptions are valid. In no case should the assumptions be carried to acceptance testing without validation and analysis of the consequences.

4.2.10 Task AQ-10. Develop IOS NPE (Navy Preliminary Evaluation) Test Plans.

4.2.10.1 Objective: To develop detailed test and evaluation plans for the conduct of the Navy Preliminary Evaluations.

4.2.10.2 Description: The NPE(s) are Navy conducted evaluations of the trainer and its subsystems during development to permit early evaluation of the suitability of the trainer and to detect deficiencies early in the development process. Formative evaluation, i.e., evaluations with sample trainee and instructor personnel to determine instructional effectiveness are part of the NPE process. The final NPE establishes the readiness of the trainer for the final Navy in-plant inspection. To ensure that all features and subsystems of the IOS are exercised during the NPEs and that the results are objective, a detailed systematic plan must be prepared for the NPE. The plan must identify the test conditions, participants, criteria, tests to be conducted and the analyses of the data to be performed. The NPEs are documented by the Navy.

4.2.10.3 Inputs: The following inputs are required for IOS NPEs:

a. training curriculum/syllabus,

b. training scenarios (including worst case),

c. IOS manning concept,

d. IOS task analysis/operational flow,

e. instructor training function flow,

f. instructor/operator task performance criteria,

g. trainer MESM,

h. instructor/operator training plan,

i. test designs and measurements,

j. test termination criteria,

k. results of related prior tests,

l. FPT objectives and criteria,

m. source of "test" trainee and instructor personnel.

4.2.10.4 Action: Prepare a detailed test and evaluation plan for the NPE(s).

4.2.10.5 Outputs: A detailed test and evaluation plan for the conducting of the NPE(s) of the IOS including test conditions,

experimental design, data collection procedures, personnel to be involved, scheduling and contingency plans. The plan shall exercise all of the subsystems of the IOS and operate the IOS throughout the test training scenarios.

4.2.10.6 Impact: The NPEs represent the last opportunity to evaluate the suitability and performance of the IOS prior to in-plant testing (specification compliance) and shipping. The tests therefore must exercise the training hardware and software to the requirements of the training mission and environment to ensure that the trainer will be ready for on-site operational acceptance testing. Failure to achieve this assurance will result in delays in bringing the trainer on-line for training as well as increasing the costs of the device.

4.2.10.7 Contingency Tasks: Each NPE involving the IOS must have a detailed test plan to ensure the collection of valid and reliable data to meet the objectives of the test. Simple exercising of the IOS will not expose all, nor necessarily the most serious, deficiencies or problems because of the many significant interactions which exist. Control of the many variables involved in IOS test and evaluation must be addressed and implemented. Therefore, no NPE involving the IOS should be initiated until a detailed plan for conducting the test has been developed. At the minimum, the test plan must specify:

a. each test point initial conditions including station configuration, station manning (and skill levels), and test conductor,

b. data collection points, frequency and formats,

c. conditions to be controlled and techniques to be employed,

d. test termination criteria,

e. data reduction and results analysis methods to be used,

f. contingency actions in cases of subsystem failure or degradation,

g. personnel and training required.

4.2.11 Task: AQ-11: Conduct IOS NPE.

4.2.11.1 Objective: To evaluate the IOS's potential and suitability, to detect deficiencies in the IOS as early as possible and to establish readiness for government in-plant inspection.

4.2.11.2 Description: NPEs are conducted at selected milestones during trainer development where the design implementation has progressed sufficiently to permit operating tests and evaluations to be conducted. The tests are conducted by the Navy and involve the ultimate users as well as weapon system specialists and consultants. The ultimate objective of the NPE is to establish that the trainer is ready or suitable for the government in-plant inspection which when satisfactorily completed, results in the trainer being shipped and installed at the user site for final testing and acceptance. The evaluation of the IOS as part of the NPEs is conducted in accordance with the test and evaluation plans developed. Although there is latitude for modification and expansion of the plan during the evaluation to explore unforeseen problems or operational potentials, the basic evaluation plan for each NPE must be followed rigorously to ensure valid and objective conclusions are reached.

4.2.11.3 Inputs: The NPE test and evaluation plan including objectives, scope, test conditions, data to be collected, data analysis and reduction procedures, schedule, documentation and test trainees and instructor personnel is required.

4.2.11.4 Action: Conduct the NPE in accordance with the plan and document the results. In particular, operability of the IOS in accordance with the test syllabi, curriculum, scenarios and manning concept and training capability must be established before the trainer is determined to be ready for government in-plant inspection. FPT support should be utilized.

4.2.11.5 Outputs: Each NPE is documented in terms of deficiencies, changes required, and suitability of the subsystems and trainer capabilities. The final NPE attests to the trainer's readiness for in-plant inspection.

4.2.11.6 Impact: Early detection of trainer deficiencies is vital to cost effective trainer development. The evaluations require that the detailed plan be followed to ensure that the objectives of each NPE are achieved and that valid conclusions can be reached.

4.2.11.7 Contingency Tasks: Not applicable. The NPE(s) must be conducted in accordance with a test and evaluation plan.

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4.2.12 Task AQ-12. IOS Acceptance Test Plan

4.2.12.1 Objective: To outline the detailed test plan for conducting the IOS portion of the acceptance test of the trainer.

4.2.12.2 Description: The acceptance tests are the final tests conducted on the trainer and establish the trainer's readiness for use in operational training. They also constitute the Navy's acceptance of the trainer from the developer. The tests are conducted at the training site utilizing Navy personnel. The test should include a complete exercising of all subsystems of the trainer in all modes and conditions of operation. Because of the importance to ultimate training operations, the tests must be defined in detail, implemented in accordance with that plan and the data analyzed carefully.

4.2.12.3 Inputs: The following inputs are required:

a. detailed training syllabus, events and scenarios,

b. trainer syllabus Minimum Essential Subsystem Matrix (MESM),

c. instructor guides,

d. training performance criteria,

e. training function support criteria,

f. IOS manning requirements by syllabus event,

g. instructor and operator qualification criteria (skill levels),

h. FPT support constraints and capabilities,

i. trainee characteristics including entry level skills and knowledge.

4.2.12.4 Action: Develop a detailed plan for the operational test and evaluation of the IOS as part of the trainer acceptance test. The plan must exercise the trainer throughout the syllabus envelope including degraded requirements. It must be designed to produce objective data on the training capabilities of the trainer relative to the requirements and constraints involved.

4.2.12.5 Outputs: The output is a detailed test plan which identifies the specific tests to be conducted including:

a. qualifications of personnel to man the trainer,

b. entry level characteristics of "test students",

c. syllabus events to be utilized,

d. detailed training scenarios to be implemented,

e. controls to be implemented,

f. data to be collected and forms for recording the data,

g. test management and control procedures,

h. initial conditions criteria (go/no-go conditions),

i. test termination criteria and plan update procedures,

j. data reduction procedures,

k. documentation required.

4.2.12.6 Impact: The acceptance test is the last opportunity to identify trainer design defects and deficiencies as well as to identify training requirements deficiencies which must be corrected before the trainer can be effectively utilized for training. Thus, the trainer must be exercised throughout its training performance envelope to ensure that the required performance exists and the trainer is capable of performing throughout this performance envelope. Once the tests are satisfactorily completed, the trainer becomes operational and the users must live with any problems which have not been corrected until and if funds can be made available for modification.

4.2.12.7 Contingency Tasks. There are no contingency tasks. The test plan for the IOS must be developed.

4.2.13 Task: AQ-13: IOS Acceptance Testing

4.2.13.1 Objective: Conduct the acceptance testing of the IOS in accordance with the test plan.

4.2.13.2 Inputs: The following inputs are required:

a. the detailed IOS acceptance test plan including schedule and materials,

b. test personnel including test trainees and instructors/ operators.

4.2.13.3 Action: Conduct the acceptance testing as outlined in the test plan and in coordination with FPT testing.

4.2.13.4 Output: Test results, discrepancies to be corrected, and recommendations for acceptance as ready-for-training.

4.2.13.5 Impact: The acceptance of the IOS as part of the overall acceptance test certifies that it meets the stated requirements and is in all respects ready for operational training. Any changes required to the trainer after this point requires use of the engineering change procedures and the time delays involved. It is therefore essential that all design deficiencies be identified during these tests.

4.2.13.6 Contingency Tasks: Not applicable. The acceptance testing cannot be performed without a test and evaluation plan.

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SECTION V

IOS SUPPORT PHASE TASKS

5.1 GENERAL. Figure 5 outlines the IOS related tasks which occur during the support phase of the trainer's life cycle. Most of the tasks as shown, are repeated regularly during this phase of the trainer life cycle. In general, the basic tasks involve identifying changes required to enhance and update the training program as well as the updating of all of the documentation affected by the system change and modification. Four decision blocks are shown, three of which trigger the initiation of tasks related to ensuring that the IOS subsystem is updated and modified as required. These decision blocks result in tasks related to the type of support event involved and include:

o trainer change - a procedure for modifying or updating the trainer to incorporate weapon system changes or training changes such as syllabus changes, manning changes, training method modifications and performance criteria changes,

o quality assurance and revalidation (QA&R) - a periodic evaluation of trainer quality and configuration,

o training effectiveness evaluation (TEE) - a periodic evaluation of the trainers effectiveness in the training program,

o trainer retirement - the end of the trainer's operational life.

The trainer users and the FPT provide essential inputs to the tasks and must be utilized to ensure that the task objectives are met and reflect the operational training needs.

5.2 SUPPORT PHASE TASKS. Each of the IOS support phase tasks outlined in Figure 5 are described in terms of task objective, general description, inputs and actions required, outputs of the task, impact on the support phase and any contingency tasks which must be performed if the required inputs are not available.

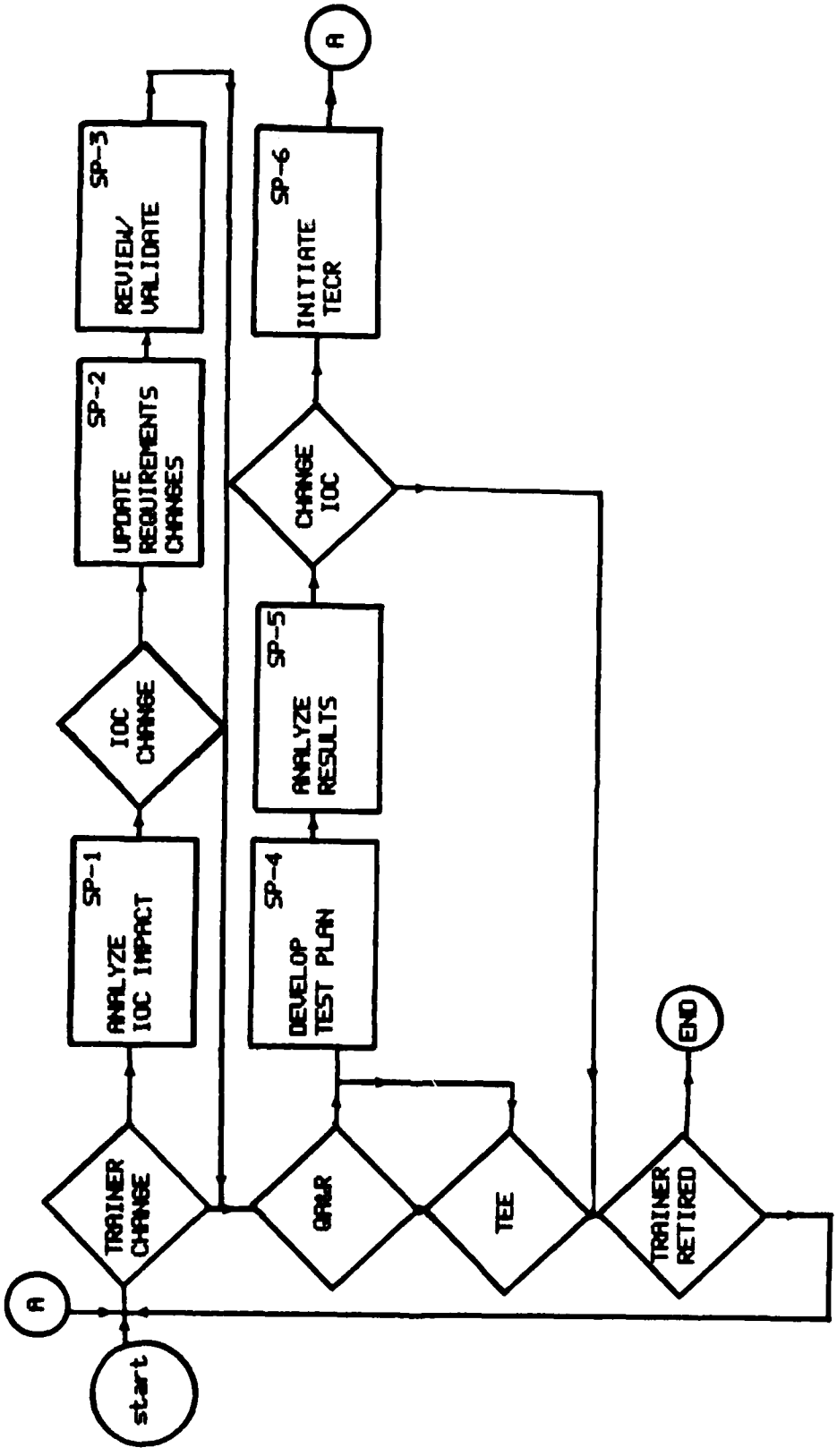

Figure 5. Support phase tasks

5.2.1 Task SP-1. Analyze IOS Change Impact.

5.2.1.1 Objective: To identify the impact on the IOS subsystem operation and baseline configuration of proposed training system changes.

5.2.1.2 Description: Any proposed change to a trainer system including documentation, syllabi, manning or scenario changes requires a IOS subsystem impact analysis to ensure that any required IOS subsystem changes are identified and implemented. While syllabi and scenario changes may involve a relatively simple analysis, weapon system changes require a detailed analysis of the trainer subsystems to expose change requirements.

5.2.1.3 Inputs: The primary inputs are trainer change proposals and requests including training change proposals such as to the syllabi, criteria or methodology. The change procedures and formats are defined in the trainer configuration and quality control procedures which have been implemented for the trainer.

5.2.1.4 Actions: Each change request, proposal or requirement must be evaluated for impact on the IOS subsystem, both in terms of configuration and operation. Changes involving the following specific areas must be analyzed in detail:

o crew tasks especially those involving displays and controls,

o weapon system tactics or operations which affect training scenarios, syllabus events or crew performance objectives,

o trainer hardware or software which interfaces with the IOS subsystem,

o instructor/operator training,

o instructing/operating features,

o syllabi or training methods.

5.2.1.5 Outputs: The output of the task is a list of the IOS subsystem elements which are impacted or potentially impacted by the proposed change. It also identifies the IOS analyses and documents which must be updated as part of the change implementation.

5.2.1.6 Impact: Identification of the impact on the IOS subsystem of a proposed change to the trainer system is essential to preclude the degradation of the trainer's effectiveness.

5.2.1.7 Contingency Tasks: There are no contingency tasks. Each proposed trainer change must be evaluated for IOS subsystem impact prior to implementation.

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5.2.2 Task SP-2. Update Requirements and Specifications.

5.2.2.1 Objective: To update the IOS requirements and specification documents to reflect the proposed trainer change.

5.2.2.2 Description: Each of the IOS subsystem requirements and specification documents developed during the pre-contract phase which are affected by the change must be updated. This also requires the updating of the analyses on which the requirement or specification were based.

5.2.2.3 Inputs: Two inputs to the task are required. The first is a list of IOS impacts identified in Task SP-1 above; the second is the current set of requirements and specifications developed during the pre-contract phase of the trainer life cycle along with the supporting analysis reports.

5.2.2.4 Action: Update the analyses and requirements documents impacted by the proposed change as identified in Task SP-1. At the minimum this will require updating of the Military Characteristic and the performance specification. Generally, the change will also require update of the weapon system task analysis, the crew training requirements, the instructor/operator training requirements, the syllabi and the IOS test and evaluation plan.

5.2.2.5 Outputs: The outputs are updates of all of the impacted requirements and specifications (and supporting analyses) documents.

5.2.2.6 Impact: Updating of the requirements and specifications is required not only to ensure that the description of the change is incorporated and compatible with the existing documents, but also to ensure that a justified baseline for configuration control is available.

5.2.2.7 Contingency Tasks: The IOS subsystem definition and development documentation (precontract and acquisition phases) is essential to the task. If the existing documentation does not reflect the current configuration of the trainer, the first effort must be devoted to updating the existing documentation before attempting to incorporate the requirements contained in the proposed change.

Where the background documentation does not exist, the initial efforts must be devoted to the development of the required basic documentation. This includes the training objectives, the syllabi, the IOS functional specification and the IOS detailed specification. Since the trainer exists, these documents will reflect the current trainer and training program configuration. Therefore, extreme caution must be exercised in utilizing these data since they may reflect trainer design rather than weapon system training requirements.

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5.2.3 Task SP-3. Review/Validate Changes.

5.2.3.1 Objective: To review design changes, validate the rationale and evaluate the change(s).

5.2.3.2 Description: Approved changes are implemented through standard development procedures including development and review of the required design data, development, inspection and test and evaluation of the implemented changes. Thus the same set of tasks (as appropriate) required for the acquisition phase must be used.

5.2.3.3 Inputs: The updated requirements and test documents developed in Task SP-2 are inputs to this task.

5.2.3.4 Action: Review and validate the design changes and related documentation. Review and inspection of the change relative to the requirement is essential. Updating of the involved documentation, particularly the IOS training and maintenance manuals, the instructor/operator training program and the design data, both hardware and software, is required and should be validated.

5.2.3.5 Outputs: Test and evaluation results along with updated design data and subsystem documentation is the output of the task.

5.2.3.6 Impact: All design and implementation effort requires review and evaluation to ensure that the product meets the stated requirements. The requirement is particularly critical to the incorporation of changes to an operational training system to preclude degrading system training effectiveness and to ensure operability within the constraints identified.

5.2.3.7 Contingency Tasks: Input of the updated specifications and test and evaluation plans are essential. Therefore completion of Task SP-2 is required before initiating the design task or attempting to review and validate the change design data.

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5.2.4 Task SP-4. Develop and Implement Test Plan.

5.2.4.1 Objective: To provide detailed IOS system test plans and to conduct the tests and evaluations required. The tests and evaluations are required to periodically certify and revalidate the trainer's capabilities (e.g., the Quality Assurance and Revalidation (QA&R) test), to evaluate the trainers effectiveness, to conduct configuration audits and inspections and to test and evaluate changes and modifications incorporated in the trainer.

5.2.4.2 Description: Although each detailed test plan will vary in content as a function of the type of test to be conducted, the basic requirement for a detailed data collection and reduction plan based on standard experimental procedures is common to all. The data collection plan must reflect operational constraints and the plan must be implemented as designed.

5.2.4.3 Inputs: Two inputs are required for the development of the plan. These are:

- o objective(s) of the test,
- o implementation constraints.

The objective should be stated such that a valid hypothesis and criteria can be developed. The constraints should include time and personnel (including test instructors and trainees).

5.2.4.4 Actions: Develop and implement a detailed experimentally valid test and evaluation plan. The plan includes the hypothesis being tested, the detailed experimental plan including data collection procedures, personnel to be utilized both as instructors/operators and as trainees and any special equipment requirements, schedule, instructions for conducting the test and contingency plans, especially for handling equipment failures and missing test points or training events. The test is implemented and documented as outlined in the plan.

5.2.4.5 Outputs: The output is a detailed test plan and when completed, the results of the test or evaluation.

5.2.4.6 Impact: A detailed plan followed by a rigorous implementation is essential to a valid test and evaluation.

5.2.4.7 Contingency Tasks: There are no contingency tasks.

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5.2.5 Task SP-5. Analyze Results.

5.2.5.1 Objective: To evaluate the results of the test and evaluations conducted.

5.2.5.2 Description: The results of the tests and evaluations conducted during the operational life of the trainer are evaluated to identify any changes required.

5.2.5.3 Inputs: The experimental plan and the data from the evaluations (Task SP-4) are the inputs.

5.2.5.4 Actions: Analyze the results of the evaluations in terms of the objectives of the test and evaluation and identify any change(s) required to maintain or increase the effectiveness of the IOS.

5.2.5.5 Outputs: IOS problem areas and change concepts based on the results of the test and evaluation are output.

5.2.5.6 Impact: Improvements and updates to the IOS are contingent on objective analysis of the results of valid test and evaluations. Therefore, data collected and reduced in accordance with a sound experimental plan are essential to the analysis of results.

5.2.5.7 Contingency Tasks: No contingency tasks are possible. The data input to the task must be valid or no meaningful analysis is possible.

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5.2.6 Task SP-6. Initiate TECR (Trainer Engineering Change Request).

5.2.6.1 Objective: To develop a definitive request or proposal for initiating a required IOS subsystem or interface change.

5.2.6.2 Description: The trainer change document format is normally directed by the Training Device Development and Acquisition Activity (TDD/AA). However, all change documents include the following data which must be developed as part of the task:

o objective and benefits of the proposed change,

o supporting documentation,

o subsystems and documentation affected,

o date required,

o description of change,

o implementation concept including impact on ongoing training operations.

5.2.6.3 Inputs: IOS subsystem change requirements or proposals originate from a variety of sources including:

o weapon system changes which impact on the IOS,

o training requirement changes in terms of syllabi, assets, training objectives, tactics and weapon system utilization,

o trainer operation changes in terms of manning and utilization,

o IOS test and evaluation results and recommendations in terms of qualitative or quantitative manning, operability deficiencies or enhancements, instructional features.

5.2.6.4 Action: Initiate and develop the engineering change request or proposal in accordance with existing procedures.

5.2.6.5 Outputs: The output is a detailed trainer change request or proposal.

5.2.6.6 Impact: Modifications and updates of the IOS are required to incorporate weapon systems changes and tactics and operational changes, to correct trainer deficiencies and to implement improved training techniques. The changes must be implemented systematically and rationally to achieve the required improvement while retained configuration control and training effectiveness.

5.2.6.7 Contingency Task: There are no contingency tasks.

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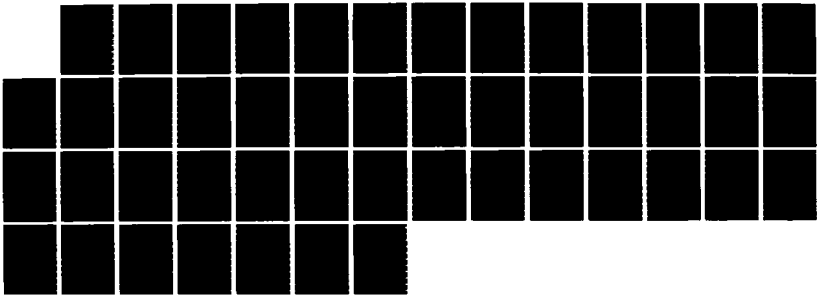

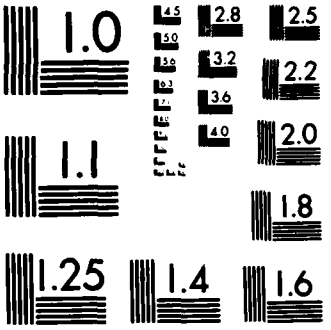

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APPENDIX A

IOS FUNCTIONAL CHARACTERISTICS

A trainer instructor/operator station (IOS) generally consists of several stations as required to support the instructing and operating staff needed to utilize the trainer for aircrew and support personnel training. A variety of IOS options exist and are utilized with training devices. Each has unique features and advantages and disadvantages. Each has specific design requirements and problems associated with it.

IOSs can be characterized in terms of the manning concept the instructing concept and the IOS location relative to the trainee station(s).

The primary manning options include:

a. instructor(s) only

b. instructor(s) and mission operator(s)

c. instructors and technician operator(s)

d. no instructors (instructorless training)

Instructors are defined as personnel trained and qualified to conduct training including evaluation of performance and modification of the training event/session to meet the needs of the trainees. Mission operators are defined as personnel trained and qualified in the operation of the trainer and experienced in the related weapon system/subsystems operation but not qualified to conduct training or evaluate trainee performance. Technician operators are personnel skilled in trainer systems operation including system power-up and power-down and the running of readiness tests. They are also often trained in trainer maintenance and troubleshooting.

Two basic instructing options are utilized either singly or in combination, namely:

a. "over-the-shoulder" - the instructor utilizes the same displays as the trainees and directly observes the actions taken by the trainees,

b. "remote" - the instructor utilizes repeater or summary displays of crewstation displays and controls and monitors student performance from these displays rather than from direct observation of the trainee and his controls and displays.

c. combination - certain team trainers have both "over-the-shoulder" and "remote" stations. For example, some instructors may be located in mockups with the trainees while other

instructors utilize remote consoles to monitor the trainees and control the training event.

Two basic locations exist for the IOS, namely:

a. On the "platform" with the student stations

b. Off the "platform" or relatively remote from the student stations.

Figure 1 outlines the options in a three dimensional matrix. Not all of the cells are filled, e.g., the cell including the instructorless option and the on-platform location are necessarily empty.

Each of the feasible cells generates unique requirements and involves different constraints on IOS design. For example, an instructor only IOS is a single place station while the instructor plus a mission operator involves a two place station unless the instructor is located on the platform. The instructor operating in an over-the-shoulder mode on a motion platform will require at least a seat belt and thus be constrained in movements.

TRAINING FUNCTIONS

Recent analyses of IOS consoles have outlined simulator training functions. Appendix B contains the instruction functions outlined by Charles and utilized in a series of IOS evaluations. The basic functions include.

a. Prepare Function - includes all tasks involved in preparing for the training event up to trainee briefing and trainer initialization. It includes the review of training data and the development of the details of the training event.

b. Briefing Function - includes briefing of the trainees and the instructing and trainer operating staff on the scheduled event.

c. Trainer Initialization Function - includes configuring the trainee station and the IOS and initializing the simulation and training programs.

d. Train Function - includes the conduct of the training event from unfreezing the trainer until the trainer is frozen again at the end of the event. It involves all of the tasks included in implementing the training event except for trainee performances evaluation.

e. Evaluate Function - includes the tasks associated with the review and analysis of the trainee's performance and the diagnosis of problems and remediation required.

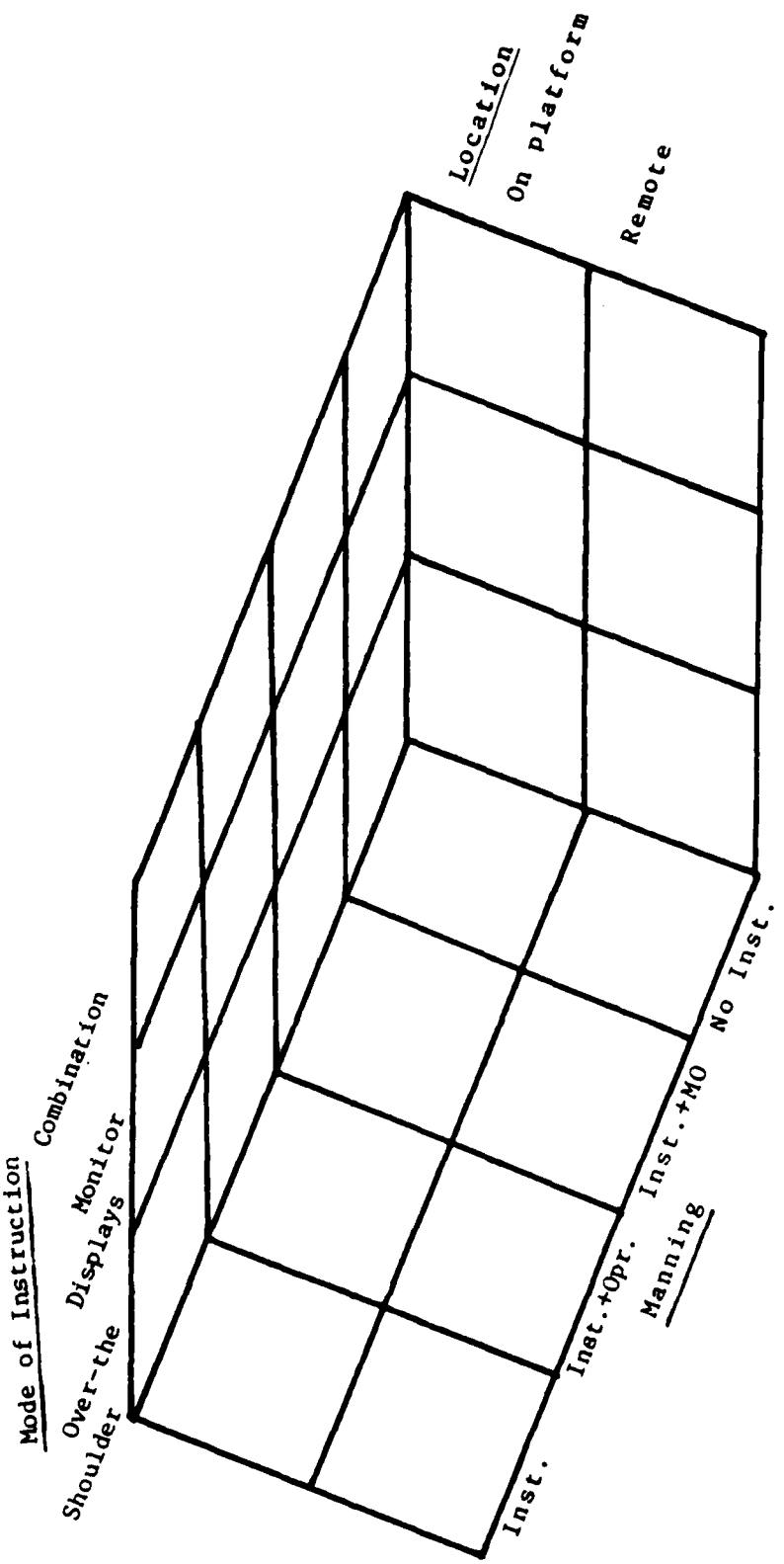

Figure 1. IOC characteristics matrix

f. Debrief Function - includes the tasks associated with providing feedback to the trainees and to the instructing staff regarding the training event.

g. Document Function - includes those tasks involved in updating student, trainer, instructor and related training files.

h. Develop Training Program Function - includes those tasks involved in creating, modifying, updating, evaluating and validating the training software and programmed training events.

i. Instructor/Operator Training Function - includes those tasks associated with training the instructor and operators in the operation and utilization of the trainer.

A more detailed analysis of these functions, as well as analyses of basic instructional methodology, subsequently revealed that three different overall functional requirements are involved in simulation training, namely:

a. trainer operating functions - those functions related to trainer system and subsystem operation,

b. trainer instructing functions - those functions related to utilization of the trainer as an instructional media,

c. trainer management functions - those functions related to managing the trainer as a training asset.

Further analysis of trainer operations indicated that at least two modes of operation also need to be addressed, namely "on-line" and "off-line" operations. For example, computer system diagnostics, report preparation and scenario programming could be performed off-line, i.e., without the simulation program running. On the other hand, training requires the simulation program. In addition, multiple simultaneous user capability will be required, especially to permit the conducting of briefing or debriefing at the same time as simulation training is being conducted.

The overall taxonomy was then used to reclassify existing function or task lists. Table 1 lists the IOS tasks for each of the three basic functions identified, i.e., operation, instruction and management. No allocation of function to man or hardware/software is implicit. The allocation step follows the function and constraint analyses.

TABLE 1. IOS FUNCTIONAL REQUIREMENTS

Operating Functions.

- System power up (includes use of computer console and equipment control panels)
- Program load (simulation/training program)
- System readiness checks
- System configuration for training
- Support of training operations
- System reset/reboot
- Data store/processing
- Scenario development/programming

Instructing Functions.

- Event preparation
- Aircrew/staff briefing
- Crewstation/console configuration
- Scenario initialization
- Instructing/performance monitoring
- Performance evaluation/assessment
- Performance problem analysis/diagnosis
- Aircrew/staff debriefing
- Instructor training/standardization/certification

Managing Functions.

- Trainer scheduling
- Aircrew scheduling
- Instructor/operator scheduling
- Aircrew training records maintenance/interface
- Instructor/operator records maintenance/interface

TABLE 1. IOS FUNCTIONAL REQUIREMENTS (cont.)

Trainer syllabi development/control

System utilization/status reporting
Training effectiveness analysis

Trainer configuration control

The three different functional categories have typically reflected three different users in terms of qualifications and job (if the functions have been allocated to manual operation). These are:

o system operator - typically a simulator technician/ computer operator,

o simulation instructor - a weapon system qualified pilot or Naval Flight Officer (NFO) who has completed simulation instructor upgrade training,

o training manager - typically a squadron pilot or NFO with collateral duty in the operations/training department.

Thus, the three functional areas are also usually manned by three differently trained and skilled personnel. Optimization of the IOS requires consideration of these skills and knowledges. It also requires designing of IOS to support the three different personnel involved, i.e., grouping of controls and displays into an effective work station reflecting user characteristics and the required integration with other user requirements.

Operating Functions. The operating functions are of two types, those concerned with system readiness, i.e., power-up, check-out and power down, and those concerned with system operation in support of other users such as instructors and managers, i.e., scenario programing, data processing and system modifications. In addition, the operating functions include establishing system configuration for the mode of operation to be implemented. In short, these functions are concerned with the simulator subsystem operation in support of the basic function - training.

The first type of function, which is concerned with subsystem operation and check-out, is not "on-line" training related and the control and displays involved can be located independent of the training console to optimize their operation. However, training support function controls and displays must be located and arranged to achieve an integrated training operational console(s).

Instructing Functions. Instructing functions include all the functions related to implementing training given an operationally ready device. The functions are of four types, namely:

Preparatory functions - event preparation, briefings, trainer initialization and configuration of the crewstation and IOS. Appendix D contains a sample briefing guide.

Training functions - scenario modification to meet aircrew special requirements, monitoring and evaluating performance, implementing instructional features and providing guidance and real time feedback (a wide variety of instructional functions should be supported by trainers - see Appendix C.)

Terminating functions - debriefing, scoring/grading and complet ion of training records.

Training Development functions - scenario development, trainer change identification, syllabus development and simulator instructor training and standardization.

A wide variety of programmed capabilities or "features" have evolved over the years to assist and unburden the simulator instructor/operator. Appendix E lists 34 such features frequently used or technically feasible.

It is clear that the allocation of these functions to reflect manning constraints is critical, since many of the tasks are literally full time tasks.

Management Functions. As indicated in Table 1, the third set of IOS functional requirements is concerned with management tasks. They range from scheduling to trainer utilization reporting. The functions must be performed either manually, as part of the IOS capability or through an interface to a training management information system (TMIS). Although few of the tasks are typically performed by the instructor (or operator),the data is integral to the conduct of training and therefore of direct concern to the IOS. Optimal design indicates that these functions be integrated with IOS requirements. Access to management data is required by the instructor in performing the Instructing Function, in particular the Preparation Function, the Briefing Function and the Debriefing Function (see Table 1).

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APPENDIX B

IOS DEFINITIONS

The following definitions apply to terms used in this guide:

CONTROLS - devices (interfaces) which permit a human operator to input data or signals to the system. They include all varieties of devices from touch panels and keyboards to switches, controls sticks and track balls to speech understanding. Three different classes of controls are utilized in training devices:

(1) simulator initialization/modification controls - utilized to set or modify simulation parameters including environment and vehicle simulation conditions. The control inputs are normally discrete. They are associated with data displays.

(2) training features/functions controls - utilized to conduct training. The control inputs are normally discrete. They are primarily associated with status displays.

(3) simulation support controls - utilized to provide manual simulations such as other weapon system crewmembers or vehicle inputs which have not been incorporated in the simulation capability or which require instructor interaction.

CREW - the personnel required to perform trainer or weapon system functions and normally scoped or sized in terms of the function involved.

DISPLAYS - devices which present data to the user via one of the human sense modalities. Visual, auditory, kinesthetic and tactile are most commonly used in training devices. There are three classes of displays, data displays which are used to manage the simulator and are of medium priority during training, monitor displays which are used to evaluate and control the training event and are of high priority during training, and status displays which are used to review and record the training event and are of relatively low priority during training.

(1) data displays - provide information on the simulation and training parameter options available. The data is generally discrete and quantitative in nature. Visual indicators and alphanumeric displays are most commonly used.

(2) monitor displays - provide real time information on the state of the simulation, the simulated world and the trainee's reactions to the simulation and the problem involved. The information includes both quantitative and qualitative data in discrete and continuous form. Graphics and analog displays are most commonly used. Auditory display of communications is included.

(3) status displays - provide a "snapshot" or summary of specified conditions or subsystems. The data may be either discrete or analog. In the latter case a track or trace is normally used for display. The data are often output in hardcopy and/or stored for use in briefing/debriefing.

FORMATIVE EVALUATION - testing of training devices and scenarios before the training device leaves the production facility to determine their instructional effectiveness.

INDICATORS - visual signals used to alert the operator to a state or change in state of a parameter, subsystem or training condition. Indicators are classified in terms of the priority of the information displayed and the response required.

(1) Advisory signal - presents a signal which indicates safe or normal configuration, condition of performance, operation of essential equipment, or to attract attention and impart information for routine action purposes. Advisory lights are normally green for normal subsystem operation indications, white for normal control setting or activation and blue for special subsystems operation such as communications or training functions. Colors are optional (except for red and yellow) as long as employed consistently and do not conflict with weapon system usage.

(2) Caution signal - presents a signal which alerts the operator to an impending dangerous condition requiring attention, but not necessarily immediate action. Caution indicators are aviation yellow in color.

(3) Warning Signal - presents a signal which indicates the existence of a hazardous condition requiring immediate corrective action. Warning signals are aviation red in color.

PANEL - The front face of an assembly, normally used for mounting controls and displays.

SPECIFIC BEHAVIORAL OBJECTIVES (SBO) - identify the component skills and knowledges required for each operator task including the action to be performed and the conditions involved.

INSTRUCTOR/OPERATOR STATION (IOS) - provides all of the controls and displays required to conduct a training mission including operation of the device, the instructional features in support of training, the brief/debrief station and the exercise/scenario programming console. It does not include displays and controls to control and check out training device auxiliary subsystems such as pneumatic, hydraulic, computational and electrical subsystems other than indicators providing necessary advisory information on the state of these subsystems. The station or console includes instructor stations (IS) and may include special support mission operator stations (MOS) and technician operator stations (TOS).

(1) Instructor Station (IS) - that console or portion of the console that is utilized by the designated instructor in the conduct of a training event.

(2) Mission Operator Station (MOS) - that console or portion of a console that is utilized by specially trained and dedicated personnel in the operation of the trainer either in support of a designated instructor or in the conduct of designated trained events.

(3) Technician Operator Station (TOS) - that console or portion of a console that is utilized by a technician trained in the operation of the device, in support of the instructor(s) or mission operator(s) during training missions and events.

TRAINING DEVICE - an item of training equipment employed in training personnel to perform a given task or series of tasks which fulfill specific training objectives. The trainer includes trainee stations, instructor/operator stations and equipment required to support the training function of the device. Included are the following trainers:

(1) Crewstation Familiarization Trainer (CFT) - A trainer which incorporates a facsimile of a crewstation of a specific system. It is used primarily to facilitate the learning of the location of the various controls, instruments, switches, and lights in the crewstation. Controls and displays are normally not functional.

(2) Crewstation Procedures Trainer (CPT) - A training device which incorporates a replica of the crewstation of a specific system. Controls and displays are functional as required to demonstrate basic procedures, antecedent and relevant stimuli and the effects of control operation. Dynamic simulation is normally not incorporated.

(3) Operational Control Trainer (OCT) - A training device which incorporates a replica of the primary vehicle (aircraft, ship, submarine, tank, etc.) control station(s) and provides a synthetic operating environment in which the crew member(s) can be trained in the operational use of all controls and displays applicable to vehicle or platform control, navigation procedures, emergency operations and such subsystems procedures as are under the control of the personnel being trained.

(4) Tactics Systems Trainer (TST) - A training device which incorporates a replica of the tactical crew stations of a specific system and provides a simulated tactical environment in which the crew members can be trained in the operational use of all controls and displays at their crewstation related to the tactical operation of the system as well as the integrated actions of the crew.

(5) Weapons System Trainer (WST) - A training device which incorporates a replica of the crew stations of a specific system and provides a synthetic operating and tactics environment in which the crew can learn and improve the skills required to function individually and as a team to accomplish the missions of the specific weapon system.

TRAINING OBJECTIVE - A statement detailing the skills, knowledge and attitudes that a trainee is expected to acquire as a result of formal training, including: (1) principles and relationships, (2) procedures, (3) perceptual-motor acts, (4) motives and attitudes, (5) identifications and discriminations and (6) techniques of decision-making and choosing courses of action.

(note: Additional definitions of terms are contained in MIL-HDBK-220, MILITARY STANDARDIZATION HANDBOOK, GLOSSARY OF TRAINING.)

APPENDIX C

TRAINING FUNCTION REQUIREMENTS

The following set of training functions is based on the list developed by Charles.

I PREPARE FUNCTION

1.1 Identify Session
- o crew(s)
- o scheduled time
- o trainer/mockup
- o syllabus event
- o simulator status

1.2 Assemble Materials
- o crew training files
- o event description
- o event scripts
- o scenarios
- o checklists/guides
- o initialization data
- o data recording sheets
- o grade sheets
- o simulator utilization sheets
- o operational plans, etc.

1.3 Review Data
- o crew history (e.g., performance problems, weaknesses, training needs)
- o syllabus event (e.g., objectives, criteria, priori ties, implementation plans, contingency plans)
- o simulator configuration and status

1.4 Develop/Formulate Training Session
- o individualize event to meet crew needs
- o modify initial conditions as necessary
- o schedule/program/modify scenario event
- o plan controller functions
- o plan/develop tactical scenario options
- o plan/program performance measurement
- o develop contingency plans (e.g., collisions/crashes, missed check points, failed procedures, trainer failures such as fire, loss of communications)
- o outline briefing (e.g., objectives, criteria, proceed- ures, simulator problems)

II BRIEF FUNCTION

2.1 Brief Crew
- o planned training evolution
- o training objectives
- o performance/mission criteria

- o simulator emergency procedures
- o simulator status/configuration
- o communications procedures
- o use of instructional features (e.g., freeze, reset)

2.2 Brief Simulator Training Staff
- o planned training evolution
- o support responsibilities
- o emergency procedures

III INITIALIZE FUNCTION

3.1 Configure Simulator
- o configure simulation system
- o configure crewstation(s)
- o configure IOS

3.2 Initialize Simulator (enter/verify initial conditions)
- o operating area, e.g. airfield location, port, runway heading, etc.
- o radio/navigation aids, locations, characteristics
- o target locations, characteristics, behavior
- o environment including weather, visibility, sea state
- o temperatures, winds, magnetic variation, etc.
- o vehicle configuration (stores, fuel)
- o vehicle position and state
- o preprogrammed malfunctions, emergencies
- o data monitoring, recording

3.3 Establish Readiness
- o crew in mockup at stations
- o area secure and safe
- o scripts, scenarios, data sheets, etc., available
- o communication check with students

IV TRAIN FUNCTION

4.1 Control Simulator
- o activate simulation
- o provide manual simulations e.g., communications, controller functions, ground/pier functions, "missing" crew functions, other platform functions such as surface threats
- o activate/deactivate emergencies, malfunctions
- o select and activate demonstrations
- o set and select replay
- o freeze simulator
- o initialize and reset
- o monitor safety of operation
- o deactivate trainer at end of session

4.2 Monitor Performance
- o procedures
- o technique

- o skill level
- o simulator performance

4.3 Instruct
- o provide feedback
- o critique
- o correct procedures, errors
- o advise

4.4 Record
- o data for feedback
- o data for simulator control, i.e., reset, replay
- o data for debrief
- o data for records

V EVALUATE FUNCTION

5.1 Monitor relevant parameters for segment, phase, task

5.2 Establish if performance is within training performance envelope

5.3 Diagnose problem if performance is inadequate

5.4 Select instruction technique for remediation

5.5 Develop plan and data to implement remediation

5.6 Brief simulator crew and student(s) as required

VI DEBRIEF FUNCTION

6.1 Debrief Student
- o organize data collected
- o assemble debriefing materials, e.g., hard copy
- o review performance problems (replay as required)
- o review correct procedures
- o outline corrective actions to be taken

6.2 Debrief Simulator Staff
- o review event implementation problems
- o review overall performance
- o discuss simulator discrepancies

VII MANAGE DATA FUNCTION

7.1 Crew Data
- o prepare grade sheets, training sheets
- o prepare training data sheets

7.2 Simulator System Data
- o utilization data sheets
- o discrepancy data sheets

7.3 Training Data
- o problems encountered in event
- o changes tried, recommended
- o instruction problems, recommendations

VIII DEVELOP SYLLABUS FUNCTION

8.1 Identify Changes Required

8.2 Format Changes

8.3 Implement Changes

8.4 Validate Changes

IX TRAIN INSTRUCTOR FUNCTION

9.1 Simulator Operation
- o console familiarization
- o console operation
- o operating procedures
- o syllabus implementation

9.2 Simulator Training
- o training functions
- o training techniques
- o evaluation
- o simulator instructing

9.3 Simulator Syllabus Development
- o training objectives embedding
- o performance criteria allocation
- o formatting/programming
- o evaluation
- o support material requirements

9.4 Training Standardization
- o event implementation
- o performance evaluation

APPENDIX D

SAMPLE BRIEFING GUIDE

A sample briefing guide for an aircrew training event is outlined below.

MISSION DATA

1. Time Hack
2. Threat of the Day
3. Mission Objectives
4. Mission Overview
5. Mission Data Card
   a. Deputy Lead
   b. Joker/Bingo Fuel
6. Weather/Moon Illumination (Night Mission)
7. NOTAMS
8. Personal Equipment
9. FCIF/Pubs/Maps

GROUND PROCEDURES

1. Preflight
   a. Aircraft
   b. Armament
2. Check-in
3. Taxi
4. Spare Procedures

DEPARTURE

1. Takeoff
   a. Runway Line-up
   b. Takeoff Interval
   c. Formation Takeoff
2. Departure/Join-up
3. Formation
4. Systems Check

RECOVERY

1. Rejoin
2. Type Recovery
3. Flight Break-up
4. Pattern and Landing
5. After Landing

ALTERNATE MISSIONS

ABNORMAL PROCEDURES

1. Aborts
2. Low Altitude Ejection

3. Landing Immediately After Takeoff
4. Jettison Procedures
5. Lost Wingman
6. Radio Inoperative
7. RESCAP
8. Emergency/Alternate Airfields

SPECIAL SUBJECTS (When Applicable)

1. Spatial Disorientation/Visual Illusions/Perceptions
2. Radar/Visual Search Responsibilities (Midair Collision Avoidance)
3. Recall Procedures
4. Dissimilar Formations
5. Terrain Avoidance
6. Airspeed Restrictions
7. Fuel Awareness
8. Maneuvering Limitations
9. Recognition, Prevention and Recovery from Loss of Control
10. EP of the Day

CREW BRIEFING (as applicable)

1. Cockpit Layout
2. Change of Aircraft Control
3. Emergencies
   a. Canopy Loss
   b. Ejection
   c. Loss of Intercom

APPENDIX E

TYPICAL IOS FEATURES

A simulation trainer instructor/operator station incorporates features designed to facilitate and optimize the instructor/operator interface. A wide variety of instructional and operating features can be and have been implemented. Although the majority of features are associated with the training function as implemented by the instructor, some of the features are primarily used by the operator when he is at the IOS supporting the training evolution. Thus the features incorporate both instruction and operation functions. The typical abbreviations that have been used are shown.

1. AUTO-FREEZE ENVELOPE (LIMT) - provides for monitoring of crew performance in terms of a preset (by the instructor) envelope based on the performance objectives of the training event. It frees the instructor of routine monitoring of all parameters related to the event. Both an instructor alert and automatic freeze option are normally provided. The envelope characteristics are readily modified by the instructor during initialization as well as during the training exercise.

2. AUTOMATED SYLLABUS - provides for automatic initialization of the trainer based on student identification or the scheduled session. The feature involves the storing of the syllabus in addition to the individual programmed training events and student schedules.

3. BRIEF - provides support to the briefing of the crew regarding training mission objectives, criteria, mission characteristics, training approach, and safety considerations. The feature is interactive and allows the instructor to access the relevant data.

4. CONTROLLER MODELS - provides simulation of human controller functions. Instructors are typically relied on to provide most human controller inputs to the student aircrew to the detriment of their basic instructing function. This feature provides for the simulation of the relevant characteristics of for example, tactical controllers, airfield tower and other ground controllers, other crew members, and friendly vessels and aircraft. RECORDED COMMUNICATIONS and/or SPEECH GENERATION or CUED COMMUNICATIONS are needed to effectively implement the feature.

5. COMMUNICATIONS RECORD - provides for the recording of crew communications during training for replay either during debrief and by the student as another type of feedback. It is particularly useful in reviewing crew coordination, communications procedures and discipline and audio related threat data.

6. CRASH/COLLISION OVERRIDE (ORID) - prevents a "crash" from occurring, i.e., permits the simulation program to continue vehicle/environment simulation even though the crash envelope has been broached.

7. CUED COMMUNICATIONS (CUE) - provides for the output to the instructor of prompts for unique communications relevant to the training mission.

8. DEBRIEF - provides support to the instructor for the debriefing of the crew following the training session. It normally provides for accessing any of the instructor displays as well as specially formatted debriefing displays and data. Graphics replay, communications replay, and flag reset features are generally incorporated.

9. DYNAMIC REPLAY/DEMONSTRATION (RPLY/DEMO)- provides for replay of selected portions of a training event (or prerecorded demonstrations) for the crew in the mockup station(s) with controls and displays repeating the conditions being replayed.

10. ENVIRONMENT MODIFICATION (MODS) - permits the instructors to modify the environment (e.g., threat, meteorological, and geographical conditions) while the simulation program is running. (Note: changes during the freeze state involves the use of RESET and/or modified IC initialization).

11. EVENT MANUAL STACK (STAK) - provides for creating a list of events to be initiated by the instructor. Many training environment and system characteristics are modified during simulation, some of them preferably are under manual control because of the difficulty of defining and setting required "triggers." Yet implementing the characteristic such as a malfunction or threat modification for example, normally requires accessing relevant data pages and activating the characteristic from that page. Where display capacity is limited, this may involve losing the situation display on which the characteristic is based. The event manual stack is in effect a "scratch pad" which permits the instructor to assemble characteristics which he expects to implement in the near future and then to activate them by a single control action.

12. EVENT PROGRAMMING (PROG)- provides the capability of "assembling" and/or modifying programmed missions at the consoles by instructor personnel who are not trained in programming.

13. FLAG SET (FLAG) - provides the instructor a means of inserting a marker or flag in the simulation program which can be subsequently accessed to identify a reset condition, a debriefing point, etc. The feature should include a selectable initial increment of time to be added to the reset since the flag is normally set when the condition exists rather than when it began.

14. FLYOUT/STEAM OUT (/GO) - provides for unfreezing the trainer from a reset condition other than an IC set.

15. FREEZE/RUN (FRZE) - provides for the freeze and unfreeze of the simulation program (not parameter freeze).

16. HARDCOPY (COPY) - provides for the output of printed copy of a designated display or formatted data.

17. INITIALIZE (INIT) -provides for the selection of the simulation program initial conditions to either a pre-stored initial and sufficient condition set (with defaults) or to ICs associated and identified with an addressable training mission event.

18. INSTRUCTOR AIDS (HELP) - provides multi-level computer generated instructional assistance concerning simulation and trainer control options at the instructor/operator's request. It is normally provided on a CRT and while the system is operating in the training modes(s).

19. INSTRUCTOR ICS (ICS) - provides a selective communications system for the instructors. Because of the many alternative communication links possible with multiple instructors, multiple student/crew positions and the simulator/maintenance console, the system must provide some means of precluding interruptions of high priority communications. At least three priority levels are probably involved. Low priority communications should be "storable" for recall when time is available without requiring the sender to repeat the data.

20. INSTRUCTOR TUTORIAL (OPTR)- provides a computer based instructional program for training instructors in the operation of the trainer.

21. INTELLIGENT ADVERSARY MODELS - proviles for the generation of interactive "intelligent" adversary systems. Although actual models and the required characteristics for training can only be determined through mission analysis, the feature provides for simulation "modules" or embedded simulations which model the relevant characteristics of adversaries involved in the training mission and in a reactive manner. Thus the feature provides more than the fixed and programmed behavior of threats and adversaries found in the typical trainer. The models should range from aircraft/ships/submarines/land vehicles to radar sites and jammers to tactical commanders as required by the missions and stage of training. Instructor interactive models are feasible.

22. MALFUNCTION INSERT/REMOVAL (MALF) - provides for the selection and insertion of a systems malfunction(s), either manually or under program control, and the cancelling or removal of the malfunction(s) and effects. When automated, an alert should be provided the instructor of the impending onset of a malfunction.

23. PERFORMANCE DIAGNOSIS - provides assistance to the instructor in the analysis of performance problems. The feature is based on stored "micro-procedures" involved in trainee tasks. These elements are multi-level or nested to permit the instructor to review the task elements at whatever level is required with computer support.

24. PERFORMANCE MEASUREMENT - provides for the collection and processing of trainee performance data into a format usable by and meaningful to the instructor in evaluating performance. The feature reduces the multitude of data generated by the relevant variables for the training tasks.

25. PERFORMANCE RECORDING (PERR) - provides for the collection and storage of selected systems parameters such as missile launch parameters, bombing CEP, and navigation errors, and for output to the instructors, either in hard copy or on displays.

26. PROCEDURES MONITOR (PROC)- provides for the monitoring and display of systems normal and emergency procedures such as checklists, and the actions taken by the crew relative to the designated procedures.

27. AUTOMATED VEHICLE CONTROL (AVC) - provides for automatic operation of the vehicle to support "non-control" crew training e.g., support to the aircrew station(s) of the WST during independent modes of operation or to CIC or NTDS training without a bridge or ship handling crew.

28. PROGRAMMED MISSION/EVENT - provides a highly preprogrammed training mission which frees the instructor to monitor crew performance. Interaction is limited and is program controlled to preclude the instructor from inducing environment changes which, for example, are incompatible with later events in the programmed mission scenario. The missions are normally developed to the detailed requirements of the specific training objectives involved.

29. PROGRAMMED QUALIFICATION EVENTS - provides a stylized "test" mission which can be used to assess crew qualifications in a standardized event. Instructor interaction is minimal. The feature has been used for example to conduct instrument flight qualification and fixed weapons delivery qualifications. The feature is generally supported by performance measurement features.

30. RECORDED COMMUNICATIONS (RCOMM)- provides for the output through the crew communications system (radio and ICS) of pre-recorded communications under either program or manual control.

31. REPLAY (graphics) (RPLY)- provides for a replay of selected instructor console displays from either the start of the event or from a selected point in the recorded event. (This

should not be confused with dynamic mission replay for the aircrew in the cockpit as provided on many trainers.)

32. RESET (to IC/Mission) (RSET) - reinitialization of a "frozen" simulation program to the previously selected set or to a sufficient preprogrammed set of initial conditions, either stored individually or as part of a training event (sufficient refers to the required set which may include default conditions),

33. SPEECH GENERATION (SPK) - provides human speech inputs to the crew. Computer driven speech synthesis can provide support to controller models as well as output of routine communications to the crew regarding the evolution of the training event. Support to the instructor ICS feature is a possibility.

34. SPEECH UNDERSTANDING (HEAR) - provides for the use of speech input for control of the trainer. Computer supported speech understanding can provide a means for inputting commands and data into the system when other modes are fully occupied, e.g., when the hands are occupied with continuous control functions.

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APPENDIX F

TYPICAL TRAINER MESM

TRAINING DEVICE 14B49 (S-3A POSITION TRAINER)

(From OPNAV Instruction 54421.4G)

A) 14B49 (S-3A POSITION TRAINER) MESM

EOC		Missions A B C D E F G H J K L
	Need For Mission B - Full Training Mission Capability	
C30	SONO MONITOR AND BYPASS PANEL (TACCO)	X X
C31	ATR	X X
C32	ESM	X X
C33	MAD CONTROL BOX	X X
C34	RADR SCAN CONVERTER	X X
C35	RIU	X X
	Need For Mission C - Capable of More Than 90% of Syllabus Training Missions	
D60	DATA LINK	X X X
	Need For Mission D - Capable of More than 80% of Syllabus Training Missions	
E11	MANUAL SESCOS	X X X X
E12	COPILOT INCOS	X X X X
E13	INS	X X X X
E14	COPILOT MPD	X X X X
E15	OFFLINE ACOUSTIC CAPABILITY	X X X X
E16	SLP DISPLAY	X X X X
	Need For Mission E - Capable of More than 70% of Syllabus Training Missions	
F30	ASA-65	X X X X X
F31	TACCO MPD	X X X X X
F32	TACCO INCOS	X X X X X
F33	SLU	X X X X X
	Need For Mission F - Capable of More Than 60% of Syllabus Training Missions	
G60	Time Code Generator (TCG)	X X X X X X
G61	Acoustic Signal Generator (ASG)	X X X X X X
G62	SFC-1	X X X X X X
G63	SFC-2	X X X X X X
G64	ARU	X X X X X X
G65	INSTRUCTOR ARU REPEATOR	X X X X X X
G66	IRC	X X X X X X
	Need For Mission G - Capable of More Than 50% of Syllabus Training Missions	
J30	SENSO MPD	X X X X X X X
J31	SENSO INCOS	X X X X X X X
J32	SONO MONITOR AND BYPASS PANEL (SENSO)	X X X X X X X

14B49 (S-3A POSITION TRAINER) MESM (Continued) (A

Need For Mission J - Capable of More Than 30% of Syllabus Training Missions

K60	TSD/SLP PRINTER	X	X	X	X	X	X	X	X	X
K61	TSD DISPLAY	X	X	X	X	X	X	X	X	X
K62	SRX	X	X	X	X	X	X	X	X	X
K63	ACOUSTIC COMPUTER	X	X	X	X	X	X	X	X	X
K64	ADP	X	X	X	X	X	X	X	X	X

Need For Mission K - Capable of More Than 20% of Syllabus Training Missions

L11	ICS	X	X	X	X	X	X	X	X	X
L12	GPDC	X	X	X	X	X	X	X	X	X
L13	TTC (PT MODE)	X	X	X	X	X	X	X	X	X
L14	PCM CONTROL	X	X	X	X	X	X	X	X	X
L15	DGU	X	X	X	X	X	X	X	X	X
L16	DMTU	X	X	X	X	X	X	X	X	X
L17	TACTICS COMPUTER	X	X	X	X	X	X	X	X	X
L18	CONTROL COMPUTER	X	X	X	X	X	X	X	X	X
L19	INSTRUCTOR MPD REPEATER	X	X	X	X	X	X	X	X	X
L20	HEADSETS	X	X	X	X	X	X	X	X	X

Need For Mission L - Capable of Less Than 20% of Syllabus Training Missions
Category Z - Not Mission Capable

Z36	FACILITY AIR CONDITIONING AND UTILITIES	X	X	X	X	X	X	X	X	X
Z89	SPECIAL INSPECTION	X	X	X	X	X	X	X	X	X
Z91	PHASE/CALENDAR INSPECTION	X	X	X	X	X	X	X	X	X
Z92	CORROSION INSPECTION	X	X	X	X	X	X	X	X	X
Z93	TECHNICAL DIRECTIVE COMPLIANCE	X	X	X	X	X	X	X	X	X

MISSION DESCRIPTION

14B49 (S-3A POSITION TRAINER) (A

OPTIMUM PERFORMANCE CAPABILITY (OPC)

A. Maximized capability for successful completion of all CNO approved Type Commander Formal Course and/or FUNCWING Readiness Directive Syllabus Missions through the availability of all equipments.

FULL TRAINING MISSION CAPABILITY (FMC)

B. Capable of completing all CNO approved Type Commander Formal Course and/or FUNCWING Readiness Directive Syllabus Training Missions.

PARTIAL MISSION CAPABLE (PMC)

C. Capable of more than 90% of Syllabus Training Missions.

D. Capable of more than 80% of Syllabus Training Missions.

E. Capable of more than 70% of Syllabus Training Missions.

F. Capable of more than 60% of Syllabus Training Missions.

G. Capable of more than 50% of Syllabus Training Missions.

H. Capable of more than 40% of Syllabus Training Missions.

J. Capable of more than 30% of Syllabus Training Missions.

K. Capable of more than 20% of Syllabus Training Missions.

L. Capable of less than 20% of Syllabus Training Missions.

APPENDIX G

TYPICAL CDRL DATA FOR IOS REVIEW

The following data items taken from NAVTRAEQUIPCEN bulletin 422-1B, AUTHORIZED DATA LIST dated 1 March 1983 are of direct interest to the FPT and should be reviewed by the team prior to being approved and or accepted. The column to the right lists the Data Item Description number. The starred (*) items are of particular importance to the FPT.

1. Planned Maintenance System Documentation	L-20304*
2. Manual Technical, Standard	M-2044*
3. Computer Program Test Plan	T-2142
4. Operator's Manual	M-2145*
5. Software Change Proposal, Software Enhancement Proposal	E-2177*
6. Task Analysis Report	H-5429*
7. Design Change Notices	V-7009*
8. Training and Training Equipment Plan	H-7066*
9. Training Courses Proposal	H-7067*
10. Task and Skill Analysis Report	H-7068*
11. Training Course/Curriculum Outlines	H-7069*
12. Instructor/Lesson Guides - Training Courses	H-7070*
13. Student's Training Course Guides	H-7071*
14. Audiovisual Aids, Master Reproducibles and Review Copies for Training Equipment and Courses	H-7072
15. Audiovisual Aids Index for Training Equipment and Training Courses	H-7073
16. Tests for Measurement of Student Achievement	H-7074
17. Student and Training Course Evaluation Forms	H-7075
18. Instructor's Utilization Handbook for Simulation Equipment	H-7076*
19. On-the-Job Training Handbook	H-7077
20. Technician Hands-On Training System Packets	H-7078
21. Conference Agenda	A-7088*
22. Conference Minutes	A-7089*
23. Maintainability Program Plan	R-7103*
24. Training Equipment Sub-System Configuration Data List	E-25504
25. Training Equipment Summary	E-25510*
26. Trainer Engineering Report	E-25555*
27. Trainer Mockup Report	E-25565*
28. Manual, Technical, Operation and Maintenance Instructions	M-25575
29. Trainer Facilities Report	P-25579*
30. Trainer Installation Requirements Report	P-25580*
31. Trainer Reliability and Maintainability Design Analysis Report	R-25585*
32. Trainer Criteria Report	S-25589*
33. Trainer Engineering Design Report	S-25591*
34. Trainer Math Model Report	S-25592
35. Trainer Test Procedures and Results Report	T-25594*
36. Manual, Technical, Functionally Oriented Technical	

	Manual for Training Devices	M-25597
37.	Trainer Technical Progress Report	A-25602*
38.	Trainer Engineering Change Proposal Summary	E-25603
39.	Trainer Specification	E-25604*
40.	Maintenance Plan	L-25602*
41.	Plan, Integrated Logistics Support	L-25622*
42.	Training Programming Report	E-25706
43.	Requirements Traceability Matrix	E-25841
44.	Program Performance Specification	E-25843

Note: Some of the above items are redundant depending on the data required and procured.

APPENDIX H

PROPOSED IOS ABBREVIATIONS

Abbreviations utilized on IOS panels and displays shall conform to the following general rules. The rules shall be applied in sequence.

Rule 1. Abbreviations shall conform to the weapon system crew-station abbreviation.

Rule 2. Abbreviations shall conform to the list of abbreviations constrained in this document.

Rule 3. New abbreviations if essential, shall be formed phonetically and shall be checked to ensure that they do not conflict with existing abbreviations defined above. In general, abbreviations shall be avoided if they are not contained in Rule 1 and 2 above.

IOS ABBREVIATIONS

-A-

AAA	Anti-aircraft artillery
AC	Alternating current
ACCEL	Accelerate
ACLS	Automatic carrier landing system
ACM	Air combat maneuvering
ACTV	Active
ADF	Automatic direction finder
ADJ	Adjust
ADV	Advance
AFCS	Automatic flight control system
AFT	After (direction)
AGC	Automatic gain control
AHRS	Automatic heading reference system
AICS	Airborne intercept missile system
ALT	Altitude
AMCS	Airborne missile control system
ANT	Antenna
AOA	Angle-of-attack
APC	Approach power compensator
APPR	Approach
ARM	Armament
ASE	Allowable steering error
ASSOC	Associate
ATC	Air traffic control
ATDS	Airborne tactical data system
ATTK	Attack
AUTH	Authority
AUTO	Automatic
AUX	Auxillary
AVAIL	Available

AWL	All weather landing (system)
AZ	Azmith

-B-

BARO	Barometric
BATT	Battery
BDHI	Bearing-distance-heading indicator
BEAC	Beacon
BIT	Built-in-test
BRK	Break
BRG	Bearing
BRT	Brightness

-C-

CADC	Central air data computer
CAP	Combat air patrol
CAT	Catapult
CATC	Carrier air traffic control
CIC	Combat information center
CHAL	Challange
CHAN	Channel
CHG	Change
CHK	Check
CMD	Command
CMPTR	Computer
CNI	Communication-navigation-identification (system)
CNTR	Center
COMB	Combine, combination
COMM	Communication
COMP	Compass
CONFIG	Configuration
CONN	Connect
CORR	Correct
CPLR	Coupler
CPU	Central Processor Unit
CRS	Course
CRT	Cathode Ray Tube
CTR	Center
CTRL	Control
CV	Carrier (ship)

-D-

DC	Direct current
DECM	Defensive electronic countermeasures
DECR	Decrease
DEF	Defense, defensive
DEG	Degree(s)
DEMO	Demonstration
DEST	Destination
DET	Detect
DG	Directional Gyro

DIFF	Difference
DISPL	Displacement
D/L	Data link
DME	Distance measuring equipment
DRLMS	Digital radar land mass system

-E-

E	East
ECM	Electronic Countermeasures
ELEV	Elevation
ELEC	Electric, electrical
EMERG	Emergency
ENG	Engine
ENGAG	Engage
ENT	Enter
ERR	Error
ESC	Escape
ESS	Essential
EST	Estimate
EXT	External
EXTND	Extend

-F-

FF	Fuel flow
FLT	Flight
FORM	Formation
FREQ	Frequency
FRZE	Freeze
FUS	Fuselage
FWD	Forward

-G-

GCA	Ground controlled approach
GCI	Ground controlled intercept
GEN	Generator
GMT	Greenwich meantime
GND	Ground
GS	Ground speed

-H-

HDG	Heading
HI	High
HOR	Horizontal
HSD	Horizontal situation display
HTR	Heater
HUD	Head-up-display
HYD	Hydraulic
HZ	Hertz, cycles-per-second

-I-

IAF	Initial approach fix
ICS	Intercommunciation system
IDENT	Identify, identification
IFF	Identification friend or foe
ILS	Instrument landing system
IMN	Indicated Mach number
IMU	Inertial measurement unit
INACT	Inactive
INCR	Increase
INDEP	Independent
INIT	Initial, initialize
INS	Inertial navigation system
INST	Instrument
INSTR	Instructor
INT	Internal
INTLK	Interlock
IP	Initial point, Instructor pilot
IR	Infrared
ISOL	Isolation

-J-

JETT	Jettison

-L-

L	Left
LAT	Latitude
LCH	Launch
LDG	Landing
LIM	Limit
LIQ	Liquid
LON	Longitude
LSO	Landing signal officer
LT	Light
LWR	Lower

-M-

MAGVAR	Magnetic Variation
MAINT	Maintenance
MALF	Malfunction

MAN	Manual
MANV	Maneuver
MAX	Maximum
MECH	Mechanical
MED	Medium
MER	Multiple Ejector Rack
MGT	Management
MIC	Microphone
MID	Middle
MIN	Minimum
MRT	Military rated thrust
MSG	Message
MSL	Missile

-N-

N	North
NAR	Narrow
NAV	Navigation
NFO	Naval Flight Officer
NM	Nautical Mile
NORM	Normal
NOTAM	Notice to Airman
NOZ	Nozzle
NTDS	Navy Tactical Data System

-O-

OBC	On-board checkout
OPER	Operate, Operator
ORD	Override
OUTBD	Outboard
OVSP	Overspeed
OXY	Oxygen

-P-

PLT	Plot
POS	Position
PRESS	Pressure
PRGM	Program
PRI	Primary
PSI	Pounds-per-square-inch
PWR	Power

-Q-

QTR	Quarter
QTY	Quantity

-R-

R	Right
RAD	Radiate, Radiation
RCDR	Recorder
RCVR	Receiver
RDR	Radar
RDY	Ready
RECT	Rectifier
REF	Reference
RET	Return
RLY	Relay
RNG	Range
RPM	Revolutions per minute
RPTR	Repeater

-S-

S	South
SAM	Surface-to-air missile
SAS	Stability augmentation system
SEC	Second
SEL	Select
SENS	Sensitivity
SIF	Selective identification feature
SINS	Ship's inertial navigation system
SPBK	Speedbrake
SPCH	Speech
SPD	Speed
SPKR	Speaker
SRCH	Search
STA	Station
STAB	Stabilization
STAT	Status
SUBSYS	Subsystem
SYNC	Synchronize
SYS	System

-T-

TAC	Tactical
TACH	Tachometer
TAS	True airspeed
TEMP	Temperature
TER	Triple ejector rack
TGT	Target
THRLD	Threshold
THROT	Throttle
TID	Tactical information display

TRNG	Training
TRK	Track
TV	Television
-U-	
UHF	Ultra-high frequency (radio)
-V-	
VDI	Vertical display indicator
VECT	Vector
VEL	Velocity
VIS	Visual
VOL	Volume
-W-	
W	West
WPN	Weapon
WSHLD	Windshield
WGT	Weight
-X-	
XCVR	Transceiver
XFER	Transfer
XMIT	Transmit
XFMR	Transformer
-Y-	
-Z-	

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SELECTED ANNOTATED IOC REFERENCES

Charles, John P. Fleet Project Team Participation in Major Aviation Training Device Development, Acquisition and Support. Technical Report: NAVTRAEQUIPCEN 82-M-1131-1, Naval Training Equipment Center, Orlando, FL, June 1984.

A survey of the functioning of the Fleet Project Team in trainer acquisition was conducted and feasible solutions to implementing the teams support to trainer development are outlined.

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The application of a control model of the human operator to display and control design is explored. The technique appears useful evaluating different options.

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A wide variety of modules for implementing automated simulator training are developed and described.

Futas, G., Butler, E. and Johnson, R. AFTS Design Report. Technical Report: NAVTRAEQUIPCEN N61339-73-C-0026, Naval Training Equipment Center, Orlando, FL, December 1972.

The design of one of the early automated training systems which was demonstrated on both U.S.Navy and U.S. Air Force is described.

Goodwin, Nancy C. Cursor Positioning on an Electronic Display Using Lightpen, Lightgun, or Keyboard for Three Basic Tasks. Human Factors, 1975, 17, 289-295.

A lightpen or lightgun were shown to be five times as fast as a keyboard in cursor positioning.

Hammell, Thomas J. Submarine Advanced Reactive Tactical Training System (SMARTTS). Technical Report: NAVTRAEQUIPCEN 80-C-0079, Naval Training Equipment Center, Orlando, FL.

A preprototype advanced instructor/operator interface was developed and tested on a submarine combat system trainer. It provided a variety of modules to enhance training including stored exercises, performance monitoring, aided exercise modification and feedback generation as well as a simplified instructor/operator console.

Porter, J. E., Grady, M. W., Hicklin, M. B., and Lowe, L. F. Use of Computer Speech Understanding in Training. Technical Report NAVTRAEQUIPCEN 74-C-0048-2. Naval Training Equipment Center, Orlando, FL, June 1977.

The requirement relevant literature and existing technology are reviewed. A new approach was developed.

Siegel, Arthur I., Fischl, M. A., and MacPherson, Douglas. The Analytic Profile System (APS) for Evaluating Visual Displays. Human Factors, 1975, 17, 278-288.

A paper and pencil technique for evaluating visual displays was developed and demonstrated.

Simox, William A. A Method for Pragmatic Communication in Graphic Displays. Human Factors, 1984, 26, 483-487.

A technique for enhancing graphic displays to call attention to a key attribute is presented.

Smode, Alfred F., Gruber, Alin and Ely, Jerome H. Human Factors Technology in the Design of Simulators for Operator Training. Technical Report: NAVTRADEVCEN 1103-1, U. S. Naval Training Device Center, Port Washington, New York. 18 December 1963.

The report contains basic human engineering data relevant to trainer design in addition to some considerations for instructor station design.

Smode, Alfred F. Training Device Design: Human Factors Requirements in the Technical Approach. Technical Report: NAVTRAEQUIPCEN 71-C-0013-1, Naval Training Equipment Center, Orlando, FL, August 1972.

The report outlines the requirements for human factors inputs in training device design and methodology for accomplishing the required input.

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The guide outlines the organizations, procedures and related data relevant to Navy training device planning, procurement and support.

Tullis, Thomas S. The Formatting of Alphanumeric Displays: A Review and Analysis. Human Factors, 1983, 25, 657-682.

Computer generated alphanumeric display formatting literature is reviewed. Four characteristics are identified and measures developed for display evaluation.

Williams, Leonard J. Cognitive Load and the Functional Field of View. Human Factors, 1982, 24, 683-692.

A high level of cognitive foveal load was shown to reduce the functional peripheral field of view by about 50%.

GLOSSARY

AQ	Acquisition (phase)
CDRL	Contract Data Requirements List
CFT	Crewstation Familiarization Trainer
CPT	Crewstation Procedures Trainer
DID	Data Item Description
FPT	Fleet Project Team
IC	Initial Condition(s)
I/O	Instructor/Operator
MESM	Minimum Essential System Matrix
MC	Military Characteristic
MOS	Mission Operator Station
NPE	Navy Preliminary Evaluation
OFT	Operational Flight Trainer
IOS	Instructor/Operator Station
IS	Instructor Station
OSD	Operational Sequence Diagram
PC	Precontract (phase)
QA&R	Quality Assurance and Revalidation
SBO	Specific Behavioral Objective
SOW	Statement of Work
TECR	Trainer Engineering Change Request
TDD/AA	Training Device Development and Acquisition Activity
T&E	Test and Evaluation
TEE	Training Effectiveness Evaluation
IOS	Instructor/Operator Station
TOS	Technician Operator Station
TRA	Training Requirements Analysis
TST	Tactics Systems Trainer
WST	Weapon System Trainer

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